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A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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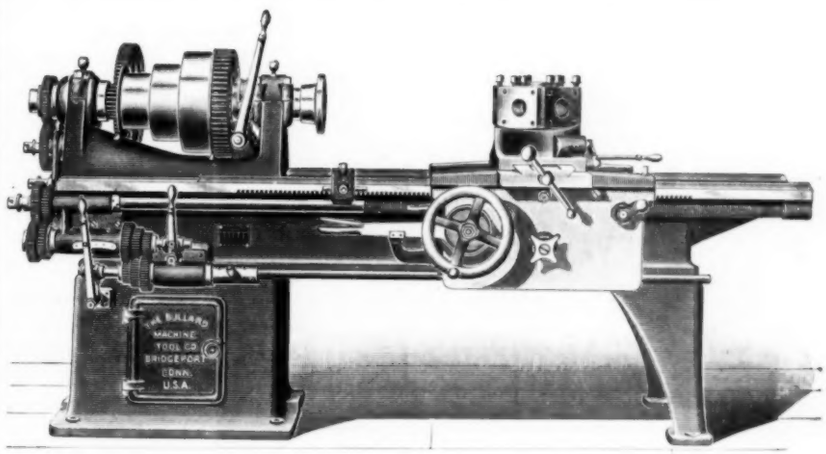

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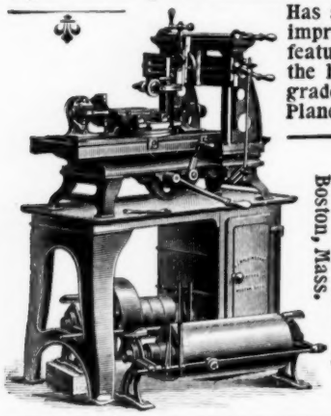

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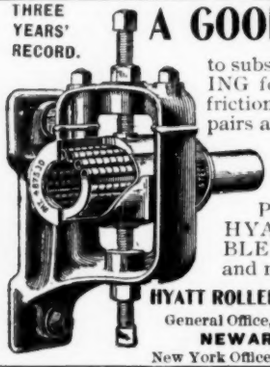

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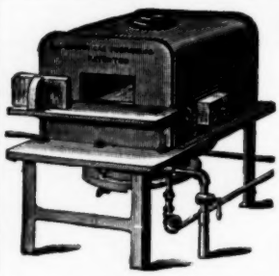

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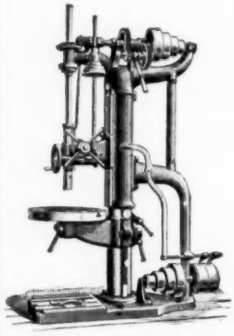

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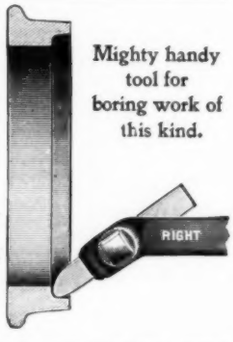

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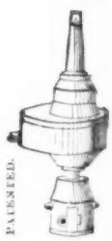

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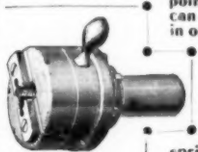

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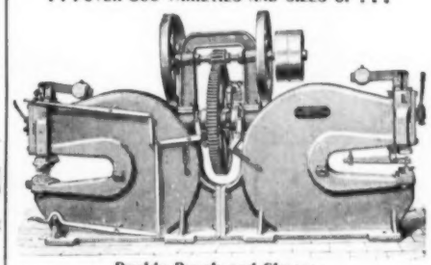

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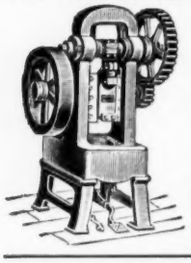

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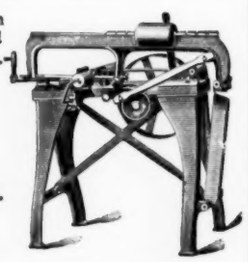

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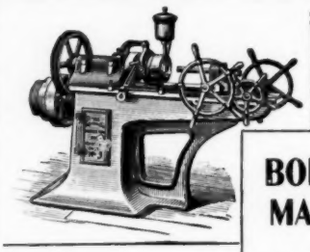

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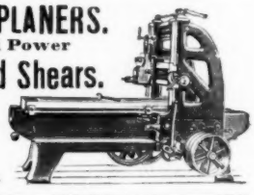

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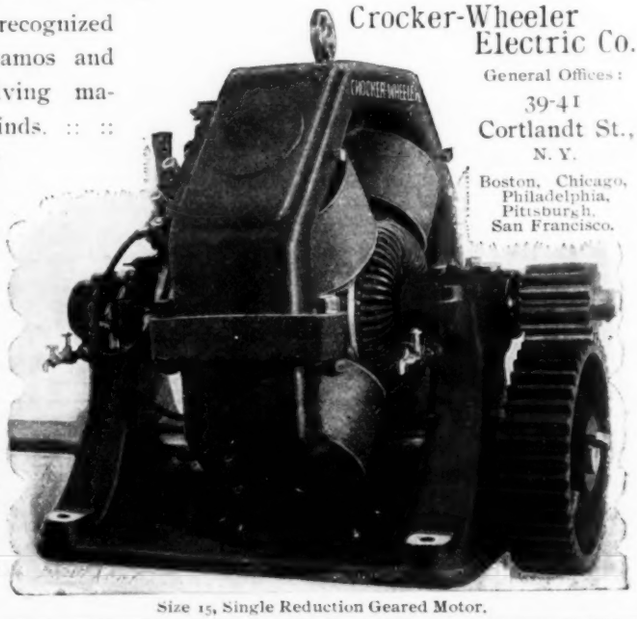

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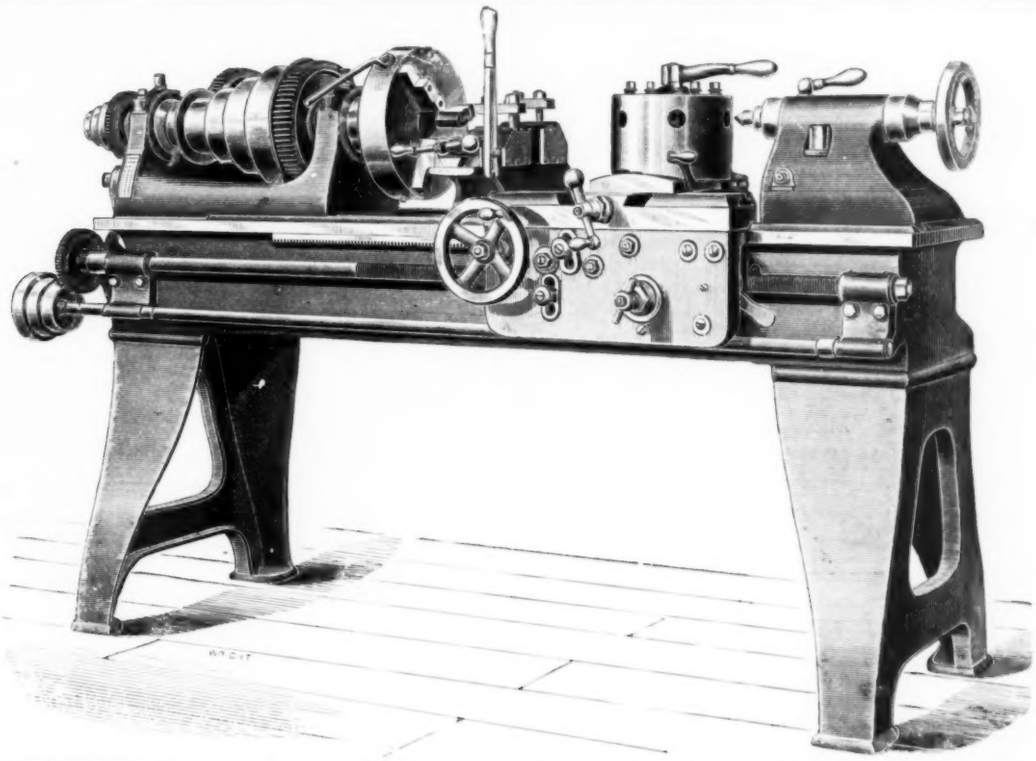

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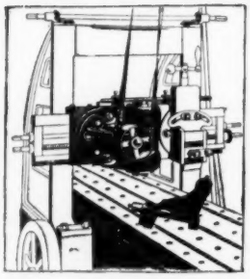

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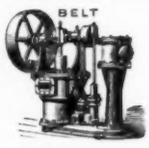

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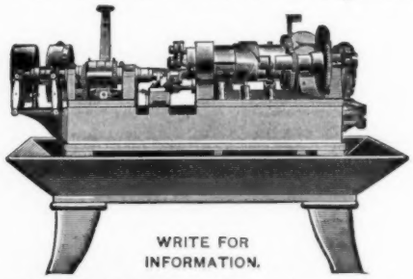

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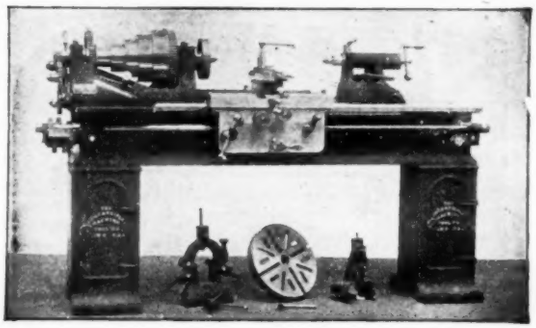

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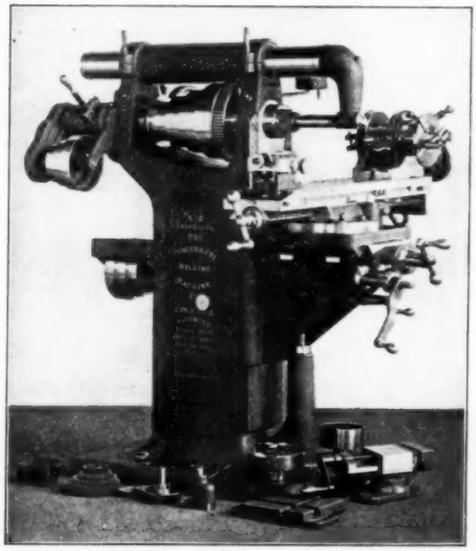

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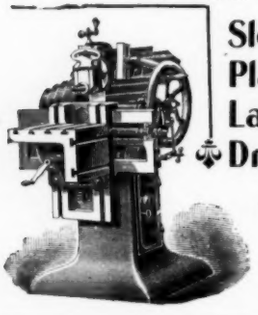

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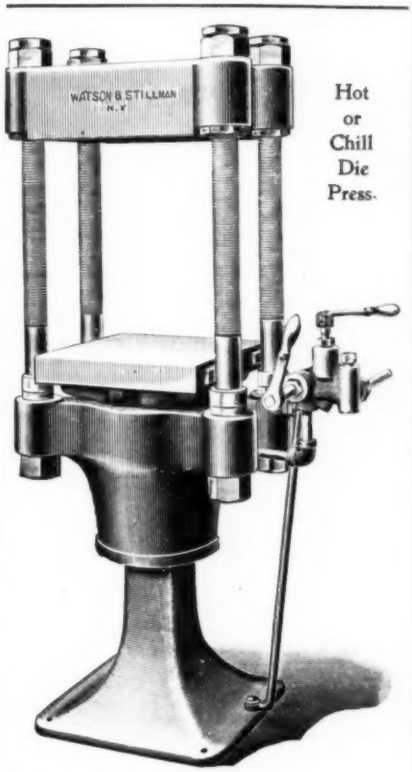

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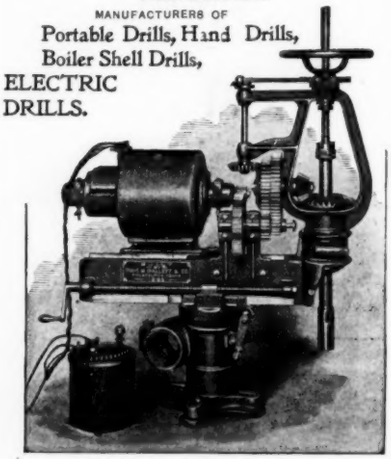

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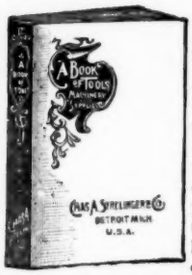

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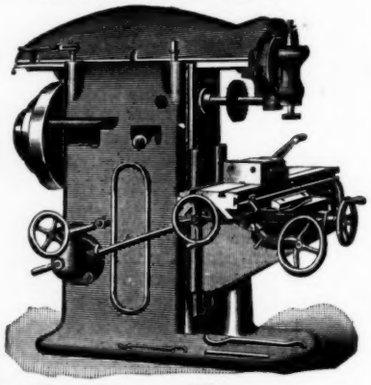

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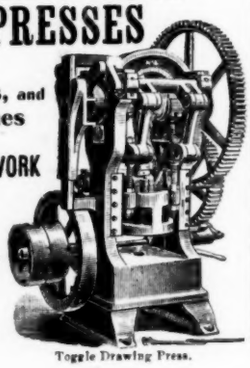
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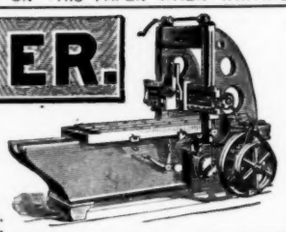

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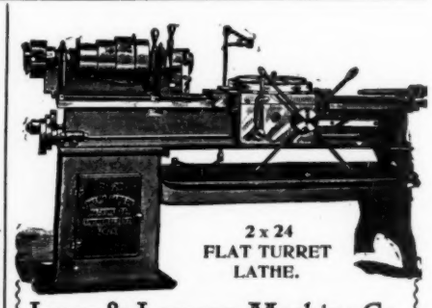

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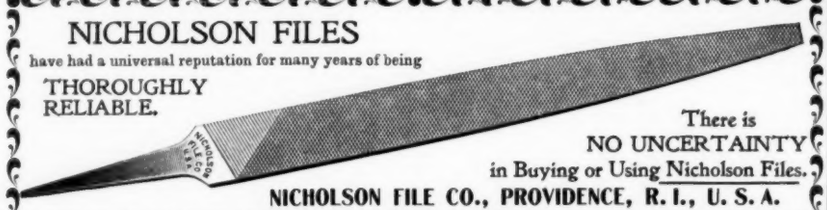

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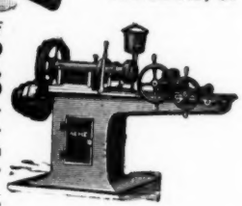

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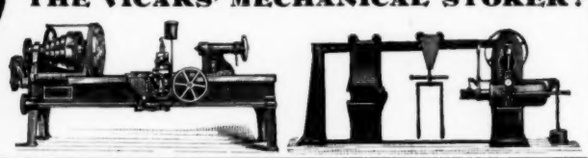

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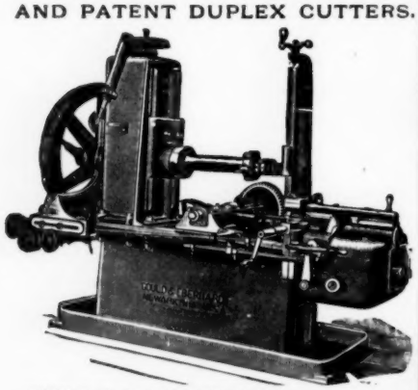

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Accurate Work on Lathe and Planer by Use of Solder.

BY A. H. CLEAVES.

To bore a hole *a*, Fig. 2, in a piece of round metal, and get it located exactly in the center, the following is a sure and convenient way:

In Fig. 1, *a* represents a chuck or face plate on a lathe; *b* a taper shank on a plug *c*. After fitting *b* into *a* and driving it in firmly, *c* having been above the required size, it is turned to the exact diameter of the work. If *c* is left long enough, then, after turning to the size required, a portion *d* can be cut off, to be used as I will explain.

Take any perfectly straight pieces having the sides *g* at right angles or square with the face plate. Then bring one of them *e* against the stud *c*, clamping it there, and at the ends to the face plate also, if convenient. With a soldering copper, float a good supply of solder along the corner *h*, Fig. 1, and remove the clamps. Bring *d* against *e*, and clamp *f* in the same manner against *c* and *d*, at *i i*, holding the ends to face plate as with *e*, and solder *f*. Then *c* and *d* can be removed. The work *a*, Fig. 2, is then laid between *e* and *f*, and soldered at 1, 2, 3, 4, when it is ready for boring.

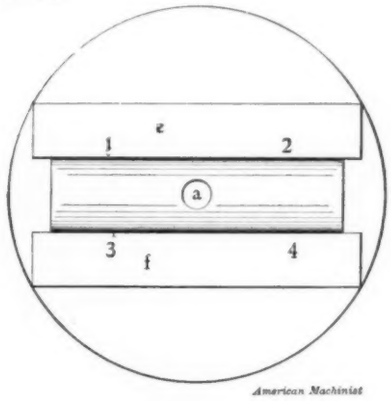
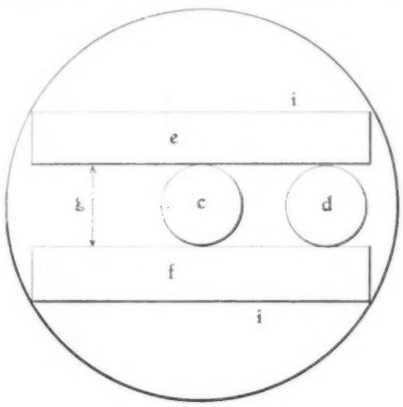


Fig. 2

WORK READY FOR BORING.

It will be seen that *a*, Fig. 2, is centrally placed on the face plate by taking *c*'s position, the chuck or face plate *a*, Fig. 1, not leaving the lathe in the process.

Every shop should have brass soldering chucks similar to *a*, or a chuck to which brass plates and hollow cylinders can be readily attached for holding work to by soldering. This solder chuck is one of the foundations of accurate work, and the metal worker who has not acquired facility in the solder touch had better tarry at Jerusalem until his beard is grown. Enough has been written about soldering, but the main points are to have the work clean, and the soldering iron clean and hot. If it has been overheated and the point crusted, file it clean and tin it again. But be sure and have it hot, so that it will flow the solder like water, using an iron as large as is necessary. There is no need of building a fire under the work, and heating the whole body to fasten the same; for you are not brazing nor sweating the metal, and do not wish to distort it with heat.



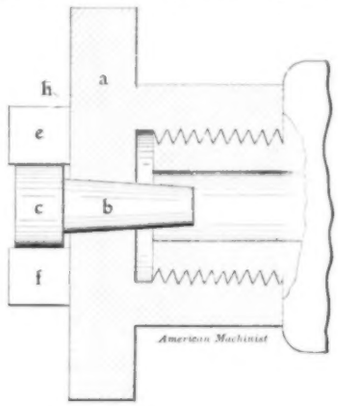


Fig. 1

RIG FOR BORING A HOLE CENTRAL AND SQUARE THROUGH A CYLINDER.

In Fig. 3 it is desired to turn or grind the piece of work *a* of uniform thickness. Then rough out the work and finish the side *e* perfectly. *b* is a hollow brass chuck. Turn the face that *c* rests against, true, and bring them together. Take any disk like *d*, for holding *c* against *b;* make a prick-punch mark in it for the lathe center *e* to enter. Then revolve the work and tap the edges of *a* lightly until approximately true, if it is intended to turn the outside. Then, with soldering iron, touch at 1, 2, etc., and finish the face *a*. If turned or ground as true as possible, the work can be ground on a cast-iron bench or surface block dead flat. Use nothing but benzine and flour emery if a fine finish on a hardened surface is required. Then wipe off all the emery and use benzine alone, as the lap will be charged sufficiently to give a fine gloss.

The accuracy in this work is obtained, as in the other instance, by making the turning or cut on the end of chuck position the work, the solder holding it without any strain or admission of dirt between the surfaces.

For accurate work on the planer or shaper, a few methods may be brought out. In Fig. 4, *a* is a cast-iron block to be used in a planer or shaper chuck, arranged to rest on the chuck jaws at 1, 2, these corners being finished. Plane the surface with the groove *c*. Then plane a brass soldering strip *b* with tongue to fit *c*. Take them together, and drill and tap

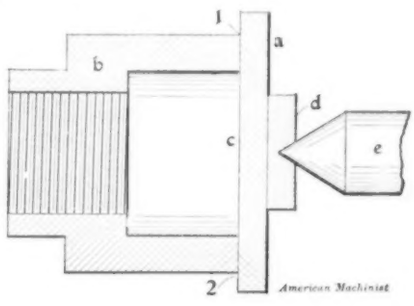


Fig. 3

MAKING A DISK TRUE.

for countersunk screws at the ends as shown. Next return *a* to the chuck, and plane off the top surface again; screw *b* onto *a* and dress top surface. Then remove *b*, and if it is required to plane a piece of steel down quite thin, say *d*, then the piece of well annealed stock may be dressed off on one side sufficiently thick to preserve its shape. Tin the finished side and wipe off surplus solder, and do the same to top side of *b;* then, while they are clamped together, heat them until they come together, tightening the clamps as the solder melts. This is called sweating, and no soldering iron is used. In the meantime the piece *a*

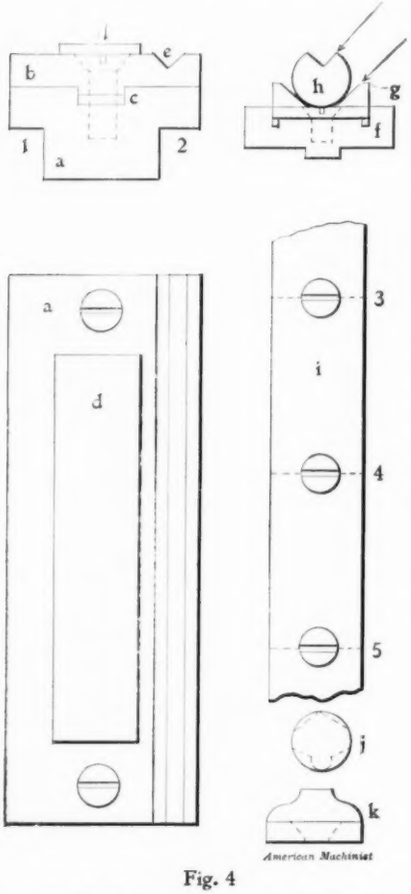


Fig. 4

A PLANER CHUCK FOR FINE WORK.

has not been removed from the chuck, so that when *b* is screwed down again the rectitude of the work is unimpaired.

If *d* is thin stock to start with, then clamp it between *b* and a thick plate, heating the whole mass as before. When it is desired to use the device again, *b* is not to be touched unless repeated heating may warp it, which it will not to any perceptible degree if it is pretty thick. But the surface of *a* must be replaned at each new use, although any number of pieces can be fastened and removed from *b* while *a* remains in the chuck.

If straight work on rods or other metal is to be done, a V-shaped groove like *e* may be found convenient. This fixture makes it convenient to take the work to the fire for soldering, rather than using an iron when inconvenient.

f is a cast iron strip fitting the planer bed groove or channel, with a sink planed in it for any piece *g* which has the ends milled or cast low enough to allow tool to pass over countersinks for screws which bind *g* to *f*. Then plane the V-groove in *g*, as shown by the arrow; that is, on one side of *g* first, and then on the other, by turning the work end for end in *f*, instead of shifting the tool holder in the planer or shaper. The finishing cut to be made without changing the tool as to depth.

Making *g* of steel or brass, round rod can be soldered to it in either of the ways described, viz., soldering with soldering iron, or heating *g* and *h* over a fire. After the work is finished, it is generally the easiest way of removing and cleaning to heat the whole thing and wipe the solder off.

At *j* and *k*, varieties of the same process are illustrated, in which the result is secured, whether in miller, planer, shaper or lathe, by reversing the work, instead of the tool provision being made for locating properly.

Or *f* being used for a drilling jig for the work, any number of pieces *i* can be made of uniform thickness by dressing the bottom of channel in *f* at each setting. Screws being used as at 3, 4, 5, and sunk below the surface, the pieces can be sawed off afterwards at dotted lines and the ends milled to required length.

Chicago, Ill.

[We should explain, perhaps, that Mr. Cleaves writes from the standpoint of a watch factory tool-maker. Some of the methods previously shown by him have been criticised as being impracticable on account of cost. But what is entirely practicable and proper in a watch factory or on similar work may not be practicable in the ordinary machine shop.—Ed.]

Molding a Rope Sheave With Match Plate.

BY L. C. JEWETT.

To mold a sheave or groove pulley, as it is sometimes called, in green sand is a task that requires considerable ability on the part of the molder, and with all ability and skill it is a slow job, as it is usually done with the regular split pattern, either with patterns in halves or with half of rim loose. Sheaves made in the above manner are frequently out of truth in the rim, it being sprung more or less when rammed up. Inclosed you will find sketches, in cross-section, showing a method of making small sheaves, 10, 12 or 16 inches diameter, that could be used where large quantities are required, and that would economize as to quantity and improve greatly as to quality.

In Fig. 1, *A* is the cope rammed up with pouring gate molded in, ready to be lifted off. *B* is the sheave pattern plated, that is made of iron, with pattern of sheave separated by having from ¼ to ½ inch of plate cast between and sufficient margin to extend out to the joint of the flask, with the flask resting on the plate, and lugs or ears for the flask pins to pass through with a good fit, not too tight, but just tight enough not to cramp when drawn off. *C* is the nowel as usually made.

In Fig. 2, *D* is a plug with a tit that is the size of the hole in center of sheave pattern. The length of the tit or projection at the bottom is the same as the thickness of the plate. The hole through *D* is to insert and guide a vent wire through the green sand core when plug *D* has pushed the core down after the cope is removed, that said cope will not crush and spoil things when closed for the last time.

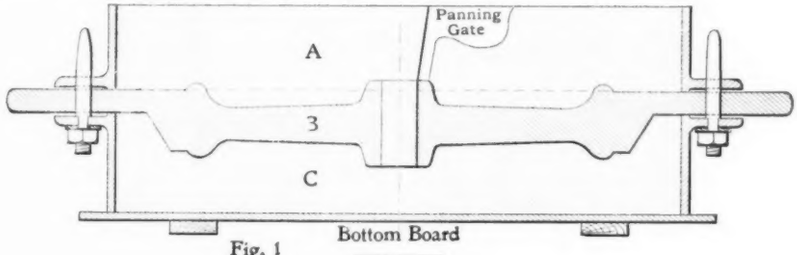


Fig. 1

Fig. 2

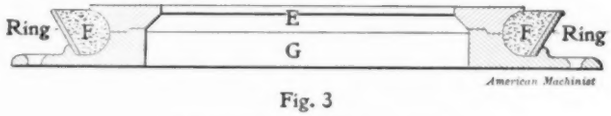


Fig. 3

MOLDING A ROPE SHEAVE.

Fig. 3 shows the groove for the sheave, made by putting a beveled ring onto *G*, inside of a projection that brings it to

true position, and no guessing about it. *E* is the top part of the arrangement wherein or whereon the groove of sheave is made. This apparatus for making the groove should be on a portable bench or stand, to be placed where convenient, and sufficiently large to hold considerable prepared sand for tucking into the rings for the grooves.

The process of molding is as follows: The molder first makes up some ten or twelve of the grooves and places them on light racks made for the particular size sheave. He then makes a mold in the flask, and after ramming up and opening flask, inserts plug *D* and vents core, draws plated pattern, sets beveled ring containing the groove for sheave, puts on cope, opens snap, and so on.

It will be seen that there are no joints to be made, no parting sand of any amount to be used. Consequently, the sand heap does not get harsh, brittle and gritty; the pattern cannot be rammed or sprung out of truth, and the sheaves will run true on the rim and not wabble, as many do, when made with split patterns. Everything about this rigging is rigid and firm; the only way to get it out of order is to take a sledge to it.

Boston, Mass.

▲ ▲ ▲

Special Drives.

BY JOHN RANDOL.

The special drive, some means by which power can be delivered at any place on the shop floor where it may be required, is a very decided element of economy in almost any shop, although it is not generally regarded as a necessity in shops making small work only, because it is always possible to move a light machine to a place where it can be temporarily driven from an idle pulley on the line shaft. If, as is often the case, the foreman and manager are in harmony with each other and can see a little way ahead, the shop may have an "odd-job" countershaft, which is not in regular use for driving a machine tool. This countershaft is not a portable drive, as it cannot be moved; but if made of pretty good length between the hangers, so that it can carry four or five pulleys of different diameters, and if it is supplied with a lot of rolls of old belting, a shaft can be made to drive almost any new or experimental machine. Such a countershaft should always extend a foot outside of its hangers at each end so as to take a laced-together belt on an overhanging pulley without unlacing, and it should be placed so as to command the erecting floor, and should have a tight and loose pulley and belt-shift so that it can be started and stopped at will. If these conditions are filled, and if the rolls of old belting are not too old, such an extra countershaft will give a pretty good account of itself, and will be in use very often in a general shop. Sometimes this extra countershaft has a night and Sunday extra hours' drive of its own, a small engine and boiler being provided to run it when the big engine is not fired up, or is shut down, and in this case the extra countershaft often develops into a length of shafting and has an old driller and a grindstone, and maybe one of Noah's lathes and an old wreck of a shaper hitched up to it, so that when a small double-time job comes in just before six o'clock the customer can have the full benefit of the antiquarian relics on his hurry work, and converse with the office about the size of his bill later when he has time to fight it out. This seems a trifle old-timeish in view of some things which are not at all uncommon in the shops of to-day, but it must be borne in mind that the "shop of to-day" speedily becomes the shop of yesterday, and there are plenty of shops of yesterday in the country—yes, and shops of last week, and shops of year before last. There are shops which think very well of themselves which haven't a tool less than ten years old in them, and have men and machines pegging along together to-day who first met thirty years ago, and the venerable combination don't turn out much work either; well as the man and machine know each other.

But even the most modern of shops can use the special countershaft to good advantage, and if I were installing a general-shop plant to-day I would put one in, and see that it had plenty of pulleys, because I know it would pay for itself every year, and more, too. It is a great convenience to be always ready to drive anything you want to drive for a little while, and drive it strong and steady, and above all to have the drive under control of a belt-shifter. Most machinists whose hair begins to be gray can remember a good many times when there was a wild dash made to throw the belt off the line-shaft pulley that was driving the new machine that was "caught" or "stuck-up" or mashing itself to pieces because something went the way it wasn't expected to go.

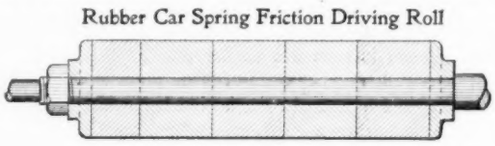
The fly-wheel opens up a lot of questions when one comes to think about the cheapest way to build it. If the shop wants fly-wheels all the time, then it is easy to tell just what to do; but where the fly-wheel or big driving pulley is a once-in-a-while job there is a chance to do some thinking. A big pit-lathe costs a good bit of money, no matter how simple it is. I don't think anything which can be classed as efficient can be put down for less than about $4,000, and then it is an awkward job to bolt the segments of gearing on the big wheel, and, take it all together, the 24-foot or 30-foot swing lathe is not a pleasure unless it is in pretty nearly constant use. There is a very good and cheap lathe of this sort at the Providence Steam Engine Works, and another larger and more powerful and much more costly at the Allis shops in Milwaukee, and as these lathes run all the time, they are cheerful objects. But where the big lathe stands still nine months in the year, it makes the manager scowl every time he looks at it, and a big boring mill that can take 11,000 pounds of metal off a 23-foot wheel, 18-inch face, in 48 hours, is not to be thought of in a shop which has not work to keep it going except a small fraction of the time.

Yet the general shop doing even a very good business may not want such a big fly-wheel very often, and in fact may not be able to economically use a boring mill of more than 8 or 10 feet capacity, and yet may well be unwilling to order a big wheel from the outside when it needs the work to keep its own hands going. In this case a special drive that will turn the big wheel good and strong after it is in place on its own shaft, lets the foreman out of his worry in fine shape.

Old John Peatie, one of the old-time Clyde productions, who could camp down anywhere with his tool box and his levels and straight-edges, and build any piece of work almost without machine tools, took a little hoisting crab that he bought out of a junk shop, and fixed it up as shown in Fig. 1, so that with the crab and a planer cross-rail he turned his fly-wheels in good time on their own shafts and in their own journals. Mr. Peatie had a little shop and built all big work. He had a pit covered by movable flooring in his erecting floor, and bored his fly-wheels with independent boring bars running in journals bolted to the wheel itself and driven from an overhead "suspended" driller spindle. After the wheel was keyed on and all in place, the crab was lag-screwed to the floor, the planer cross-rail was bolted up on the other side, and the wheel-rim was turned without costing a cent as he claimed, because as he said, "I just watch 'im myself—look—see—when I'm walkin' roun' the place." The unusual feature of Peatie's special drive was the use of the rubber car-springs to make a friction drive when forced against the face of the wheel. The friction of the rubber springs was enough to drive a cut ¼ inch deep, strongly. This is an application of the rubber friction drive which I never saw elsewhere. Indeed, I do not know of a single case where a soft rubber friction roll driver is used regularly, except in the bobbin-winders of sewing machines. I have used soft rubber bevel friction pinions in a machine tool myself, with perfect satisfaction, but never knew anyone else to try it in such a place. The engraving shows Peatie's special drive plainly without more description. The planer cross-rail had a star feed rigged to it. Of course, a fly-wheel turned this way in its own journals, after it is keyed to its own shaft, runs dead true, which is more than can be said of some independently bored and turned fly-wheels, and it is to be noted that in this rig the cutting speed takes care of itself and is always the same regardless of the size of the wheel.

Cylinder reboring is another case of

special drive. This was met in the old shops, and is generally met to-day, I think, with a portable steam-engine drive, consisting of a little engine driving a pinion



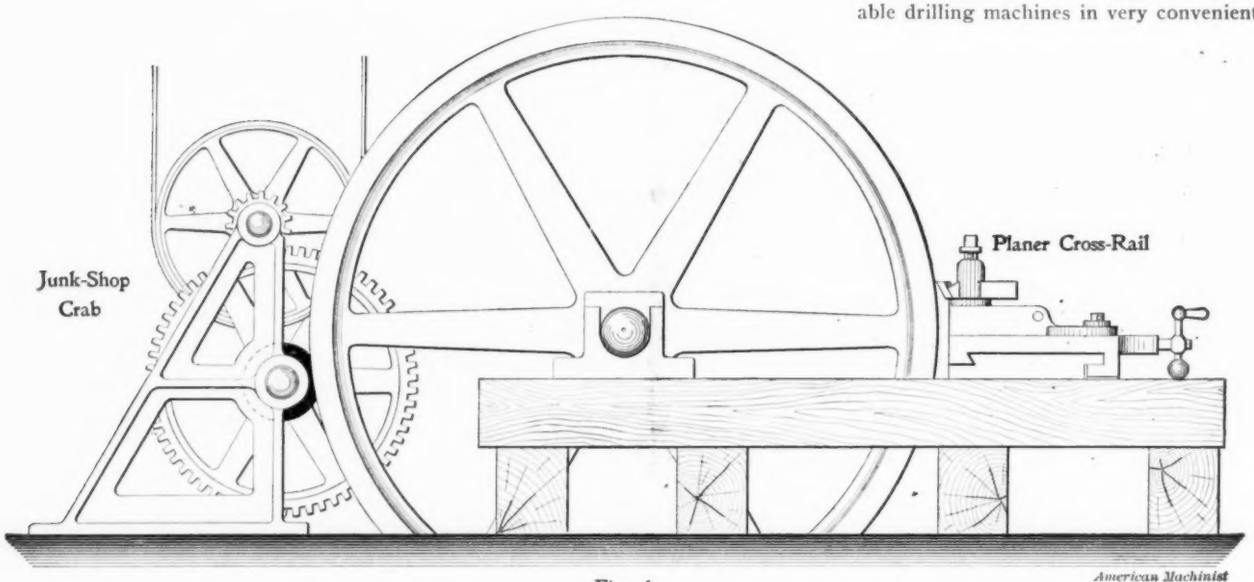


Fig. 1

JOHN PEATIE'S FLY-WHEEL TURNING RIG. Chicago, 1866. (From memory.)

which is prime mover of a train of reducing gear, the last wheel of which drives the boring bar. It is a great deal of work to pull a big cylinder up and take it to the shop for reboring, and what is of even more importance, it takes a long time to do the job. But a good boring-bar man can take a light cut through almost any cylinder between Saturday night and Monday morning, if he has things fixed up for the job and on the spot at whistle time Saturday; so the little engine came in nicely with its own little boiler, or with steam from one of the big engine boilers. But the little engine is a "has-been," a memory of antiquity, in the face of the electric motor cylinder-boring rig shown in Fig. 2, from the Milwaukee & St. Paul shops, Milwaukee, Wis. This is a vast improvement over anything previously used.

The hand-driven ratchet drill is always an eyesore to the foreman; he knows himself how easy it is to pull an inch drill by hand, and he don't tell the machinist and helper ratchet gang to "hit it up" as they twist the flat drill through maybe 6 or 8 inches of cast iron, but he does silently wish all to himself that the feed could be squeezed a little harder and the ratchet lever could be made to wag a little faster. So when the portable drill with its special rope drive came in about fifteen years ago, it was very generally welcomed by both workmen and foremen, although some of the old hands said it "spoiled trade." The rope drive was a bit awkward at times, but it did well and served its good purpose, although it must now be placed among the "has-beens." There will always be a great many places in heavy work where holes must be scribed and drilled to the marks in pieces too heavy or too big to go to a stationary drilling machine, and in this case the special drive is of great importance, handicapped though it often was in the past by difficulties in belting power to the precise spot where it was wanted.

But now we have at our command a method of transmission which leads power to any point we wish without the slightest trouble, and have it, too, applied to portable drilling machines in very convenient and effective form; so that in some large shops fitted with the latest appliances in the way of traveling cranes and floor rail-

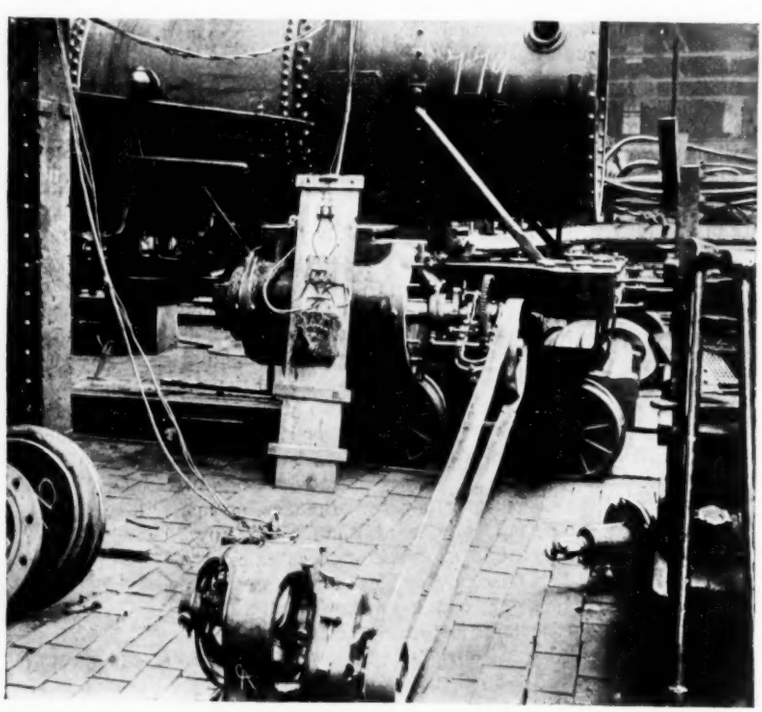


Fig. 2. BORING LOCOMOTIVE CYLINDERS BY ELECTRIC DRIVE.

way tracks, it is common to see the electric-driven "Dallett" at work on pieces which could readily be carried to the stationary drilling machine. Of course, if a piece can be drilled as quickly with a cheap portable driller as it could be by a more expensive stationary drilling machine, it is economy to do the work with the less costly tool. More especially is this true when the cost of two handlings, one to the big driller and one away from it, is to be added to the work of the big driller itself.

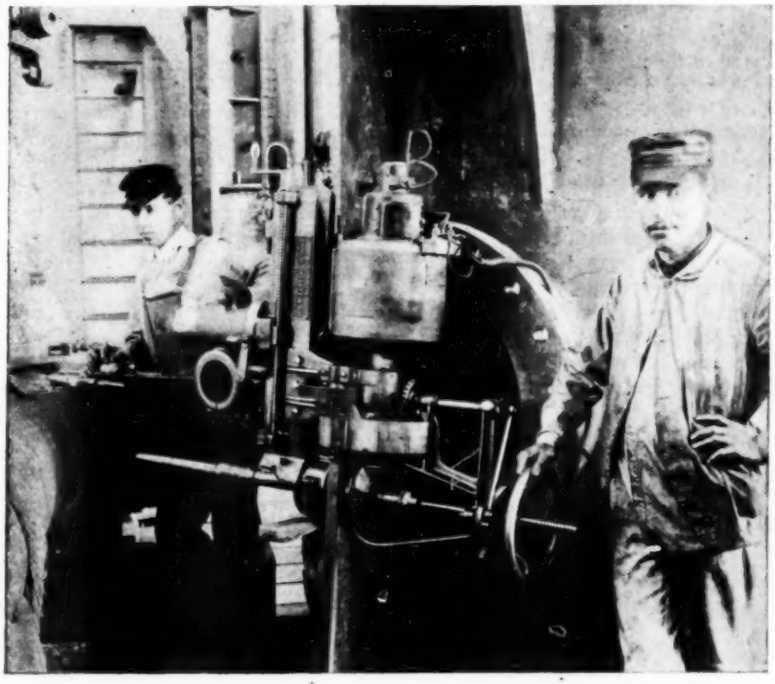


Fig. 4. ELECTRIC-DRIVEN DALLETT DRILL, DE LA VERGNE SHOPS.

Figs. 4 and 5 are from the De La Vergne shops, and show the electric-driven Dallett drill in use (in Fig. 4) as a driller, drilling holes in a very large connecting rod. Fig. 5 is a view of a similar driller, blocked up on the floor and used as a driver for a boring bar working overhead, boring some holes in the upper part of the large casting, which is receiving a coat of paint at the same time. It will be observed that an open-link drive chain is used with a large and small sprocket wheel to transmit power from the motor to the boring bar. The chain is much more convenient than a belt, as the chain is "detachable" and can very easily be made the right length to fit the job. The chain is the more certain to drive without slipping, and it also requires less tension than a belt. Some use of electricity in the machine shop is now almost invariable, and it furnishes by far the most convenient agent known for the transmission of power for any special drive. In most cases, or it might perhaps be said in all cases where a machine has a fixed location, it may properly be belted if belt-driving is the practice of the shop. But where the machine is to be moved from place to place, the electric drive is far superior to any belt, rope or independent engine drive. It is becoming common to see an electric motor mounted on a substantial truck, so that it can be readily moved to any place in the shop where a drive is required.

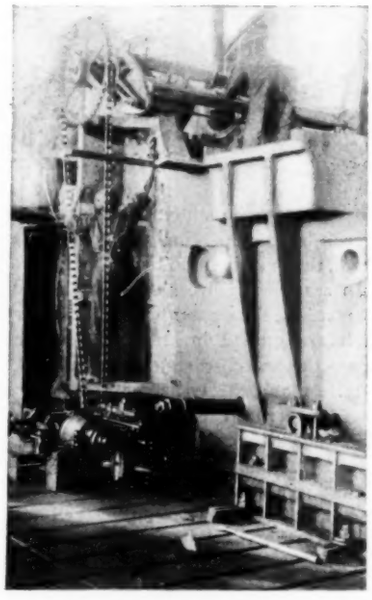


Fig. 5. ELECTRIC-DRIVEN BORING BAR.

Whatever may be thought of extending electric driving in machine shops to the extent of excluding the use of belting entirely, it seems unquestionably correct to use electricity in all cases of special drive, including the special countershaft before referred to.

I should say that the general shop would be the gainer by having an "over-time" length of shafting, electric-driven, this special length to drive a lathe, planer, shaper, driller and grindstone, and to have also an independent "special" countershaft, electric-driven, and a "Dallett" electric drill, and also an electric motor of, say, 5 horse-power mounted on a truck, to be readily placed wherever desired, either in the shop or out of it. So much for what seems proved proper in the way of the use of electricity in the general machine shop.

The small shop making large work and having only a very limited use for a large boring mill, will find old John Peatie's rubber roll drive a great convenience for finishing large wheels and pulleys, and this, too, might well have an independent electric drive.

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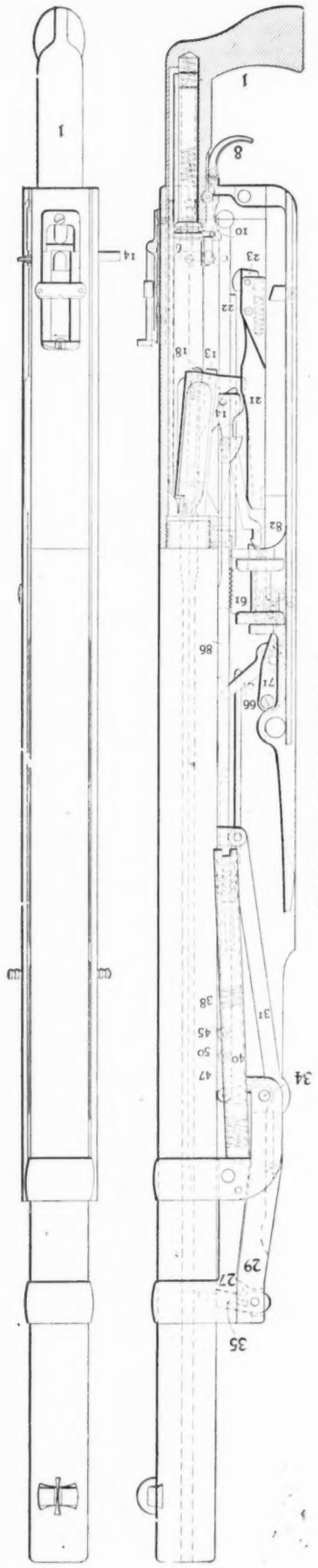
The Colt Automatic Gun.

There is probably no class of inventions of more interest to the mechanic than those relating to firearms, and especially to the ingenious mechanisms devised for their rapid and automatic loading and discharging. One of the most interesting of its class is the Colt automatic gun, built by the Colt Patent Fire Arms Manufacturing Company, Hartford, Conn., which we illustrate.

As must be said of any similar aggregation of special devices, it is not so much a distinct invention as it is a growth, or the result of a long series of world-wide experiences in which thousands have contributed each their item of improvement, and, succeeding that, of a series of exhaustive experiments by an individual inventor. The special feature of the arm may be said to be a series of devices whereby the powder gases are utilized to work automatically the firing, ejecting and reloading mechanism. It is not the easiest thing in the world for the writer to describe devices of this character, nor for the reader to follow the description however clearly it may be written, but by reference to Fig. 2 it is hoped that the action will be made reasonably clear.

A small radial vent in the barrel somewhat in rear of the muzzle, opens downward from the bore, this vent being closed by the piston 35 which fits in the gas cylinder 27 surrounding the outer end of the vent. The piston is pivoted to the gas lever 29, which is hung in the bracket on the horizontal pivot 34 so as to swing thereon in a vertical plane below and parallel to the barrel; two tubes 40 under the barrel contain spiral springs 38, which are connected by a rod 45 and links 47 and 50 with a short crank arm of the lever 29 in such a manner that the spring yieldingly holds the gas lever in the position as shown in the drawing, with the piston closing the vent. At a point between the piston and the pivot of the gas lever a rod 31 connects it with the slide 86, which,



THE COLT AUTOMATIC GUN.

guided below the barrel extends rearward beyond the latter, and is there connected with the breech-bolt 13. The breech-bolt is arranged so as to move backward and forward in opening and closing the breech, and in the forward position the rear end of the breech-bolt swings downward, turning on the front end as a fulcrum, and in this position it is sustained by abutments in the casing against which it rests.

A central rib of the breech-bolt depends into a slot in the rear end of the slide and the pin 14 passes through the slide and through the diagonal slot in the rib, and connecting the breech-bolt with the slide, causes the latter as it moves rearward, first to raise the end of the breech-bolt, thereby unlocking it, then to move it rearward, opening the breech; while the forward movement of the slide moves forward the breech-bolt, and finally forces its end down, thus closing and locking the breech.

In rear of the breech-bolt a hammer 6 is arranged, the stem of which and a spring in it are guided in an extension which closes the breech-casing and to which the handle 1 and the trigger 8 are attached; this hammer is also used as a piston for the air pump, which forces a strong jet of air into the chamber and through the barrel, removing all particles of unburnt powder, immediately after the empty shell is extracted. As the bolt moves rearward it forces back the hammer. The trigger and a sear 10, hung by the side of the trigger, serve to retain the hammer until the breech is again closed and locked, when the hammer may be released by a pull on the trigger; a connection between the slide and the sear serves to release the hammer automatically each time the breech is closed, if the pull on the trigger be continued. By this means either single shots or a continuous volley may be fired.

The feed-belt is entered through an opening in the left side of the gun and the cartridges in it pass succesively over the feed wheel 61, which is rotated by the slide 86 and the levers 66 and 71, so that at each stroke of the slide one cartridge is presented in front of the extractor 82, attached to the slide, and by it the cartridge is drawn rearward on to the carrier 21 pivoted at 22 below the breech-bolt. The empty feed belt passes from the gun through the opening in the right side of the gun, while an extractor on the breech-bolt serves to eject from the gun the empty cartridge shells in the usual manner.

The rear end of the carrier is provided with a spring dog 23, which yields to the slide in its rearward movement, and causes the first of the forward movements of the slide to raise the front of the carrier, and to present the cartridge thereon to the breech-bolt, by which it is pushed into the barrel. A firing pin 18 in the breech-bolt, so located that it can be struck by the hammer only when the breech-bolt is firmly locked, transmits the blow from the hammer to the cartridge.

THE COLT AUTOMATIC GUN.

As the automatic action of this gun is due to the direct effect upon the lever of the pressure of the gases through the vent, in contradistinction to that class of automatic arms in which the recoil of the barrel is depended on for actuation, the delicacy of the parts necessary in the latter class is avoided in this gun.

The barrel of this gun is of such strength that its accuracy is not disturbed by the vibrations incident to rapid firing; and not heating as readily as the light barrels of the other systems, the troublesome water jacket for cooling is not required.

A safety lock is provided which securely locks the hammer and prevents same from striking the firing pin. This is to be used

only when loaded cartridge is left in chamber.

The main spring, firing pin and extractor can be replaced as easily and as quickly as in the ordinary bolt gun; as all these parts can be removed from the rear of the arm without displacing a single screw.

As the pressure of the powder gases in the barrel is only used to operate the automatic action after the projectile has received its maximum velocity, the range or penetration of the arm is not impaired thereby.

The gun complete weighs about 40 pounds and can be easily handled by one man. In a test for durability, rapidity of action and non-liability of fouling, 8,000 rounds were fired, the gun showing no wear or weakness. At 200 yards, in a test for accuracy, 100 consecutive hits were made in sixteen seconds.

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A New Formula and Diagram for Combined Stresses in Shafts.

BY A. L. HOPKINS, C. E.

The question of determining the sizes of shafts subjected to combined bending and twisting, is one that admits of considerable variation in its solution, depending, as it frequently does, upon unusual conditions incident to the particular case in hand. Many as are the various considerations which bear upon the determination of shafts under combined stress, the methods and formulæ employed in such determination are hardly fewer in number, and to this fact is due, in a great measure, the apparent variation which anyone who has followed detail construction and design at any length, can hardly have failed to notice in the size of pins and shafts doing the same work and under the same conditions. This state of affairs obtains, largely no doubt, from the fact that up to the present time there have been no tests which would warrant definite conclusions upon shafts under combined stress, and we are forced, therefore, to rely upon formulæ which are largely theoretical in character or design to resist one stress alone, and allow for the other by such a factor of safety as is, in the judgment of the designer, sufficient for the particular case.

Thus, with one it is customary to determine the shaft for bending only, and add a certain amount, depending upon the ratio of such bending to the torsion; another will fix upon such a size that the deflection, under the given loads, shall not exceed a certain amount; while some make use of the formulæ given in Unwin and the various hand-books, in which the combined bending and twisting moments are reduced to an equivalent single moment, either bending or twisting.

While it is greatly to be deplored that we have no reliable tests on members under combined stress, still the writer believes that more satisfactory results and, of necessity, greater uniformity would be obtained by the use of an established formula of the character above stated, the adaptability to particular or unusual cases being obtained by proper modification of the allowed stress to be used in solving the resulting equivalent moment.

Two objections which might be offered to this manner of dealing with the question are the inconvenience of the most approved forms, those of Rankine and Grashof, and the fact that they do not readily admit of a graphical representation; that is, of curves being plotted from them, which will enable the desired size of shaft to be selected from a sheet of such curves by mere inspection.

The only curves, in fact, with which the writer is familiar, are those published in the "American Machinist" of February 20, 1896, which, though otherwise satisfactory, are plotted only for certain fixed ratios between bending and twisting moments, and are therefore open to objection on this account, since it is seldom that the ratios, occurring in practice, are exactly those contained in the curves, and their use thus involves more or less interpolation and approximation.

As a result of the conditions here briefly stated, the writer was led to attempt the deduction of a formula which should be not only convenient for general use and permit of a direct graphical representation, but which would also give results agreeing closely with those obtained by the use of the Rankine and Grashof formulæ. These two forms, as taken from Lanza's "Applied Mechanics," edition of 1891, page 893, are here given:

Rankine—$M' = \frac{1}{2} M + \frac{1}{2}\sqrt{M^2 + T^2}$

Grashof—$M' = \frac{3}{8} M + \frac{5}{8}\sqrt{M^2 + T^2}$

In which M is the given bending moment, T the given twisting moment, and M' the resulting equivalent moment.

These two equations both contain two terms in their second members—one a fractional part of the bending moment, and the other a fractional part of the square root for the sum of the squares of the two moments. If we can do away with the first term and the fractional co-efficient of the radical, we shall have a much simplified expression and one that is at once capable of being plotted as a right-angled triangle, in which the two sides correspond to the given bending and twisting moments, respectively, and the hypothenuse is the resulting equivalent bending moment.

If we attempt this, it at once becomes evident that we must introduce, within the radical, a co-efficient for T to satisfy the equation in the limiting case, where $M = 0$; it being evident that at the other limit, where $T = 0$, the formula will reduce to $M' = M$. We may then write the equation as follows:

$$M' = \sqrt{M^2 + (CT)^2} \qquad (1)$$

and proceed to determine C.

To determine a shaft for the resulting bending moment M', we will have:

$$M' = \frac{K'I'}{d'} \qquad (2)$$

where M' equals the bending moment; K', the allowed maximum fiber stress; I', the moment of inertia of section about neutral axis; and d', the distance of extreme fiber from neutral axis, equals radius of shaft.

To determine a shaft for a torsional moment T, we will have:

$$T = \frac{KI}{d} \qquad (3)$$

where T equals the torsional moment; K, the allowed maximum shearing stress; I, the polar moment of inertia about axis of section; and d, the distance of extreme fiber from axis, equals the radius of shaft.

Taking equation (1), where $M = 0$, reducing second member and substituting the values of M' and T from equations (2) and (3), we have:

$$\frac{K'I'}{d'} = C \times \frac{KI}{d} \qquad (4)$$

When $M = 0$, in equation (1), we must obtain the same size of shaft, whether we solve the first member for bending or the second for twisting, so that we have, in (4), $d' = d$. The generally adopted ratio of direct shear to tensile strength has been 0.75, but the latest tests seem to indicate that this ratio is too high, and that the true value is nearer 0.66. As a mean, let us take 0.7; that is, $K = 0.7\ K'$. Also, $I = 2 \times I'$. Substituting these values in equation (4), canceling and reducing, we have:

$$C = 0.714 \qquad (5)$$

Squaring C and applying in equation (1), we obtain, $M' = \sqrt{M^2 + 0.508\ T^2}$ or for the sake of convenience, let us say:

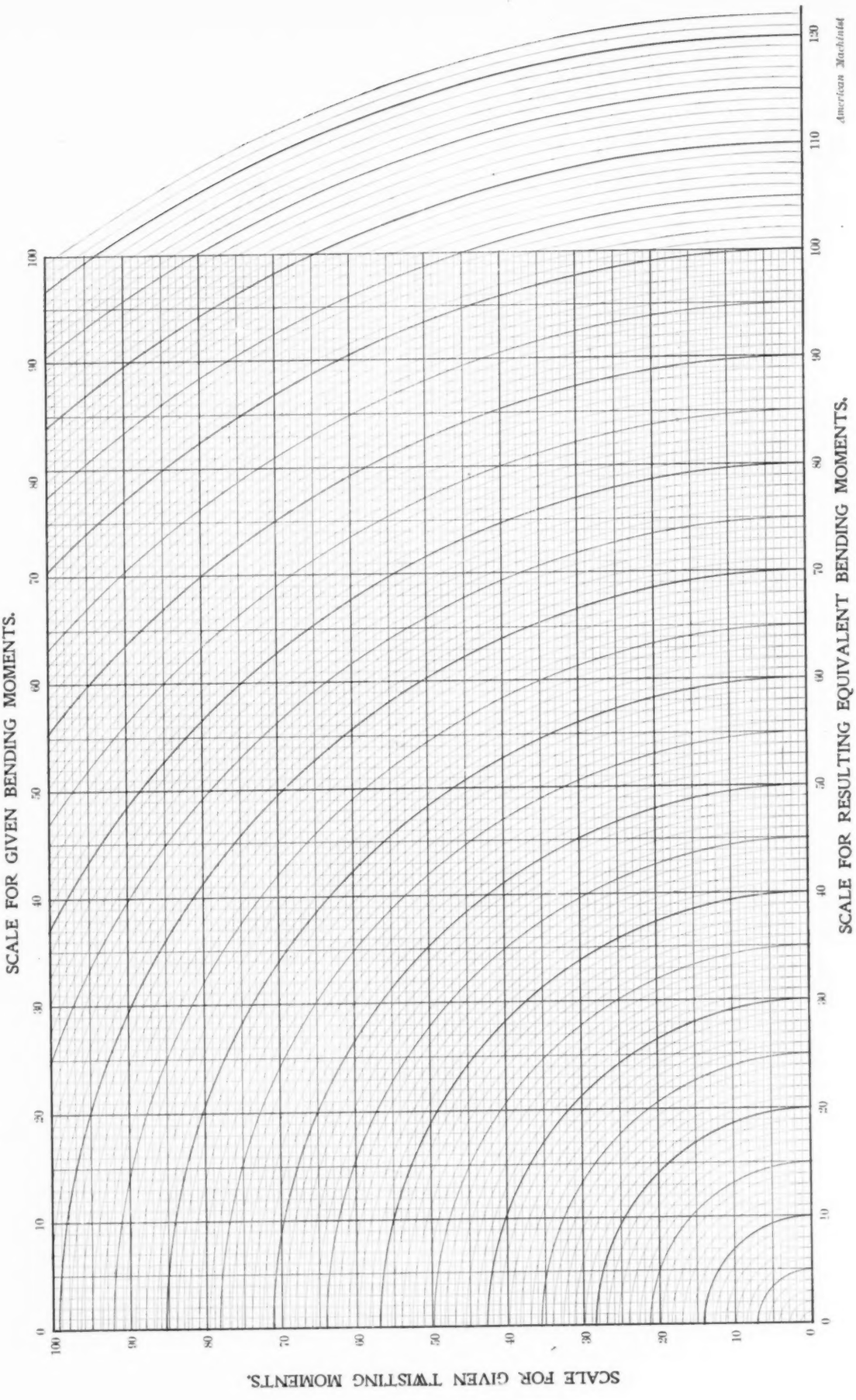
$$M' = \sqrt{M^2 + 0.5\ T^2} \qquad (6)$$

We now have a formula which is correct for the two limiting cases, namely, where $M = 0$ and where $T = 0$. It now remains to be seen what values the formula will give for intermediate conditions between these two; and having no actual results by which to test it, the best we can do is to compare its results with those given by the Rankine and Grashof forms. This was done by taking bending moments decreasing from 100,000 inch-pounds to 0, and twisting moments increasing from 0 to 100,000 inch-pounds, both by increments of 10,000 inch-pounds; applying these varying moments so that their sum always equaled 100,000 inch-pounds, and solving the resulting equivalent bending moment for circular shafts, using a fiber stress of 10,000 pounds per square inch.

The result is shown in the accompanying table, giving the dimensions of the shafts required by the different formulæ, from which it is seen that the values from equation (6), where varying from both those given by the Rankine and Grashof formulæ, fall between the latter two, except in the last two cases; and that the

EQUIVALENT BENDING MOMENT DIAGRAM FOR COMBINED BENDING AND TWISTING MOMENTS.

FORMULA — $M' = \sqrt{M^2 + 0.5\,T^2}$ In which, M = Resulting Equivalent Bending Moment, M = Given Bending Moment and T = Given Twisting Moment.



agreement with the Grashof form is very close throughout the entire range. The first column in the table gives the values in inch-pounds of the given bending and twisting moments; the second column gives the diameter in inches of the shaft, obtained by solving the resulting bending moment given by the Grashof formula; the third is the same for the Rankine, and the last for the writer's formula.

The slight variation in the last two cases is due, as may be readily seen, to the fact that if the extreme case, where $M = 0$, be solved by the Grashof formula, it will be found that the assumed ratio of shear to tensile strength in that case is 0.8; while a corresponding solution for the Rankine formula gives the ratio as 0.9. The criticism may here be made that this latter value is more probably correct, since it is well known that in shafts tested, under torsion, to breaking, the shearing strength developed was practically equal to the tensile strength of the material, and that such authorities as Unwin, Lanza and others advocate taking the tensile value of the material in determining the required size of shaft to withstand torsion.

Values of M and T.		$M' = \frac{5}{8}M + \frac{3}{8}\sqrt{M^2 + T^2}$	$M' = \frac{1}{2}M + \frac{1}{2}\sqrt{M^2 + T^2}$	$M' = \sqrt{M^2 + 0.5\,T^2}$
$M = 100{,}000$	$T = 0$	Diam. = 4".67	Diam. = 4".67	Diam. = 4".67
$M = 90{,}000$	$T = 10{,}000$	" = 4".51	" = 4".51	" = 4".51
$M = 80{,}000$	$T = 20{,}000$	" = 4".36	" = 4".36	" = 4".36
$M = 70{,}000$	$T = 30{,}000$	" = 4".20	" = 4".21	" = 4".21
$M = 60{,}000$	$T = 40{,}000$	" = 4".10	" = 4".06	" = 4".07
$M = 50{,}000$	$T = 50\,000$	" = 4".00	" = 3".95	" = 3".97
$M = 40{,}000$	$T = 60{,}000$	" = 3".94	" = 3".85	" = 3".90
$M = 30{,}000$	$T = 70\,000$	" = 3".91	" = 3".78	" = 3".89
$M = 20{,}000$	$T = 80{,}000$	" = 3".94	" = 3".74	" = 3".94
$M = 10{,}000$	$T = 90{,}000$	" = 3".95	" = 3".71	" = 4".03
$M = 0$	$T = 100{,}000$	" = 3".99	" = 3".71	" = 4".16

I would say in reply, however, that the conditions which obtain in tests which are carried to failure of the piece, are not those contemplated by the theory for determining the stresses in shafts; that is, the theory of stress in material does not apply when the elastic limit is exceeded. As is well known, the strength developed in the extreme fiber, when a beam is tested to failure, apparently exceeds the tensile strength of the material, owing, aside from any variation in the tensile and compressive values of the material, to the fact that after the extreme fibers are strained beyond their elastic limit, those fibers nearer the neutral axis come in for more than their share of the stress, as determined by the theory of flexure; that is, the fibres are no longer strained proportionately to their distance from the neutral axis. Still, it is generally customary to use only the tensile strength of the material for the working stress in the extreme fiber, and for exactly the same reason it would seem proper to use only the direct shearing value when fixing the allowed working stress in a shaft subjected to twisting efforts. It seems to the writer that this consideration of the question would dispose of some of the inconsistency implied by such statements as the following, which is taken from Lanza's "Applied Mechanics," edition of 1891, page 514: "So that, in the present state of our knowledge, we cannot explain the fact, that when the breaking shearing strength of wrought iron or steel is deduced from an experiment on torsional strength, it is found to be about equal to the tensile strength, while, when deduced from experiments on riveted joints, it is found to be about three-fourths or four-fifths the tensile strength."

Having given the grounds for the assumption made in determining the value of the co-efficient of T, from the limiting case, and having shown the resulting close agreement with the most approved of existing theoretical formulæ, a few words only are necessary as to the method of the graphical representation:

The values on the vertical scale, representing the given twisting moments, are laid off to 0.714ths of the values on the upper horizontal scale, which represents the given bending moments. The reason for this is apparent when we see that the value of C, as given by equation (5), is 0.714. In order to read the value of the hypothenuse, as measured from the origin, 0, to the intersection of the ordinates through the points laid off on the two scales, the circular arcs were swept in with the origin, 0, as a center; so that by referring to the nearest arc, and following it around to its intersection with the lower horizontal scale, the value of the resulting equivalent bending moment might be read at once on that scale. In order to economize space, the number of divisions on the two scales was kept down to 100, and the method of decimals, for reading higher values, was adopted as indicated in the directions and example given below. As the directions are quite explicit, further comment is unnecessary, the resulting equivalent bending moment being solved by the ordinary bending formula, or the result obtained from any convenient diagram for the same, a very convenient form of which has recently appeared in the pages of the "American Machinist."

DIRECTIONS FOR USING THE DIAGRAM.

Point off the same number of decimal places, both in the given bending and twisting moments, so that the greater of the two, after thus pointing off, shall not exceed 100. Spot these values on the given indicated scales and note the intersection of the ordinates through these points. Select circular arc passing nearest to this intersection; follow to the right and down, and read on the scale for resulting equivalent bending moments. Add to this reading the same number of decimal places as were pointed off in each given moment, and the result is the resultant equivalent bending moment.

EXAMPLE.

Given bending moment = 63.724. Given twisting moment = 843,200. Point off four places, giving 6.3724 and 84.3200, respectively. Selecting ordinates and noting intersection, we read, by following circular arc, 60.0 on scale for equivalent bending moments. Adding four decimals, we have 600,000 as the resultant equivalent bending moment.

Newport News, Va.

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Costing Castings by Cube Root.

At the October meeting of the American Foundrymen's Association, in the course of a discussion upon the cost of castings, the president, Mr. Francis Schumann, suggested an interesting problem. He said that there is a relation between the cost of molding a casting and the volume of sand forming the mold. Suppose a flask contains a cubic foot of sand, and the volume of the casting is 10 inches and the volume of the void is 20 inches, the difference being made up in cores and one thing or another. Then there is a certain relation between those three elements and the cost of molding, when you speak of green sand molding. The same thing applies to loam castings, but better to green sand castings.

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From a recent test of the steam consumption of a steam whistle, such as is used on a locomotive, it was deduced that the steam used would be 46.55 pounds per minute, or 2,793 pounds per hour. As steam engines use, according to the type of engine, say, from 20 to 100 pounds of steam per hour, therefore it takes from 28 to 140 horse-power in steam to blow the whitsle.

Trials of the British Cruiser "Powerful."

The recent trial of the British first-class cruiser "Powerful" was a notable one in many respects and brought out a number of highly interesting particulars which our readers will be glad to note. Speaking of the trial, "The Engineer," London, says:

"This has only been accomplished after many disappointments, consequent on unsettled weather, in addition to the natural unwillingness which a newly cradled engine so frequently displays when it is particularly urged to do its best. Twenty-five thousand horse-power must assert its dignity. It is not to be done all at once."

The exhaustiveness and exceptional severity of the trials of the "Powerful" are quite unusual with the British Admiralty. In this case there were two thirty-hour runs at 5,000 and 18,000 horse-power, respectively, and a final run of eight hours, four hours at 25,000 horse-power and four hours at 22,000.

The principal dimensions of the "Powerful" are: Length between perpendiculars, 500 feet; length over all, 538 feet; beam, 71 feet; displacement, at load draft of 27 feet, 14,250 tons. The ship is entirely of steel, except stem, stern and rudder frames, which are heavy castings of phosphor bronze, aggregating 50 tons in weight.

There are two four-cylinder triple-expansion engines, designed to develop 25,000 horse-power at 110 revolutions, and with 210 pounds pressure in the first cylinder. The steam is supplied by forty-eight Belleville water-tube boilers in eight watertight compartments. The total fire grate area is 2,200 square feet, and the heating surface is 67,800 square feet. The working pressure at the boilers is 260 pounds.

In the first thirty-hour trial, only sixteen of the boilers were used. The collective horse-power developed was 5,008; speed, 14.0 knots, and coal consumption, 2.07 pounds per indicated horse-power.

On the second thirty-hour trial the collective horse-power was 18,433; speed, 21 knots; and coal consumption, 1.838 pounds per indicated horse-power. On this trial all the Belleville boilers were in use, giving no trouble whatever.

The final trials of four hours at 25,000 horse-power and four hours at 22,000 horse-power, with no interval between them, were only accomplished after three attempts which were not carried through. Before this final trial the funnels were lengthened, the funnel casings were lagged, and various minor adjustments were made. For the first four hours the revolutions per minute were 114.4; collective indicated horse-power, 25,886; speed, 21.8 knots. For the second four hours the revolutions per minute were 109.5, and indicated horse-power 22,634; speed not taken, and the coal consumption was not recorded for either period.

The main feature of the test was considered to be in the Belleville boilers, and this was considered to be highly satisfactory in every respect.

Some minor experiments were made with the ship to determine her maneuvering ability. The time required to bring her to rest from full speed is stated by "The Engineer" to have been thirty seconds, while the engines were reversed from full speed ahead to full speed astern in thirteen seconds.

An important particular of the tests is, as "The Engineer" puts it, "that the results were obtained without any recourse that 'invention of the evil one,' forced draft, and its attendant intolerable temperatures. There was nothing of the Hades idea on these trials, the maximum temperature recorded in the engine-rooms being 75 degrees, the stokeholds themselves never exceeding 90 degrees. This is an enormous fact, enabling, as it will do, an attenuated engine-room staff to respond more readily to the severe demands which war-cruising will make on them. Certainly the temperature question will affect the speed of these ships just as their size does."

It is estimated that the capacity of the coal bunkers will enable the ship to steam 25,000 miles at ten knots, although it is possible that this does not take into account the constant coal consumption for other purposes than propulsion.

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Duplex Belt Driving.

When you have two pulleys on a shaft belted to two pulleys on another shaft, to divide the work, you cannot be too particular about the relative sizes of the pullays. We have more than once seen fans running with a pulley on each end of the spindle, but with the slack of one belt on the top while the slack of the other belt was on the bottom, showing that the work of driving was not only not properly divided between the two belts, but that one was doing all the driving, and actually dragging the other belt besides.

That we have seen, and worse cases we have heard of. There was a man in the Nutmeg State, the State prolific of inventions, who had a kindling wood splitting machine driven by a belt from an overhead shaft, and the belt seemed to be hardly sufficient to drive it comfortably, so he put a similar pulley on the other end of the machine shaft, and another pulley on the line shaft 2 or 3 inches larger in diameter, so that it would drive stronger, but he found instead that the machine with the improved drive would not go at all. The power was used up in the struggle between the belts.

At Sibley College they have an engine with two driving pulleys, each 49 inches in diameter, belted to two pulleys on another shaft, each 42 inches in diameter. It was noticed that the belts were not working equally, and not long ago the pulleys were measured. A difference of 15-32 inch was found in the circumferences of the two iron driving pulleys, although calipering the pulleys had showed "no measurable difference in size," and they do some fine calipering at Sibley College. The difference in the circumferences of the wooden driven pulleys was 5-32 inch, and the larger pulley on one shaft was belted to the smaller pulley on the other shaft, thus making matters as bad as possible. The circumference of the larger wooden pulley was reduced 5/8 inch, and then the load was found to be evenly divided between the two belts. The figures are from the "Sibley Journal of Mechanical Engineering."

Where two belts are thus employed for driving, it it usually understood that if one is overloaded, it will slip enough to give the other belt a partial, if not an equal, pull. If there is no actual slip, the belts always have some elasticity, and a certain elongation which takes place when the belt is pulling or driving is corrected by a creeping of the belt on the driving pulley surface before leaving it, and this creeping or minute slipping of the belt, which occurs to some extent on both the driving and the driven pulley, tends in either case to give the latter a slower relative speed, which will also help to throw a portion of the load upon the other driving belt.

In the case of multiple rope driving, the case would seem to be necessarily worse than with flat belts, as the practical diameters of the pulleys must vary with every variation in the depth to which the rope sinks into the groove; but here, too, the trouble is largely self-correcting. If a rope pulls harder than its fellows, that will tend to sink deeper into the groove of the driving pulley, which will mean for it that it will go around the pulley upon a shorter radius, and its linear take-up will be somewhat retarded and its load consequently lessened. There may be some argument for the continuous rope drive in preference to separate ropes, on account of the constant uniformity of rope section and the presumption that this must insure the same working radius in each groove.

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We learn that they are at present considerably more particular regarding admission of visitors to the Krupp Works than has been the case formerly. It has never been entirely easy to gain admission to all parts of the works, but now there is very considerable government work going on, regarding which it is said that secrecy is desired; and on a recent visit of Kaiser Wilhelm to the works, he declined to go through them, on the ground that if he went, his staff would necessarily have to accompany him, and that would be giving the processes and the work going on there too much publicity.

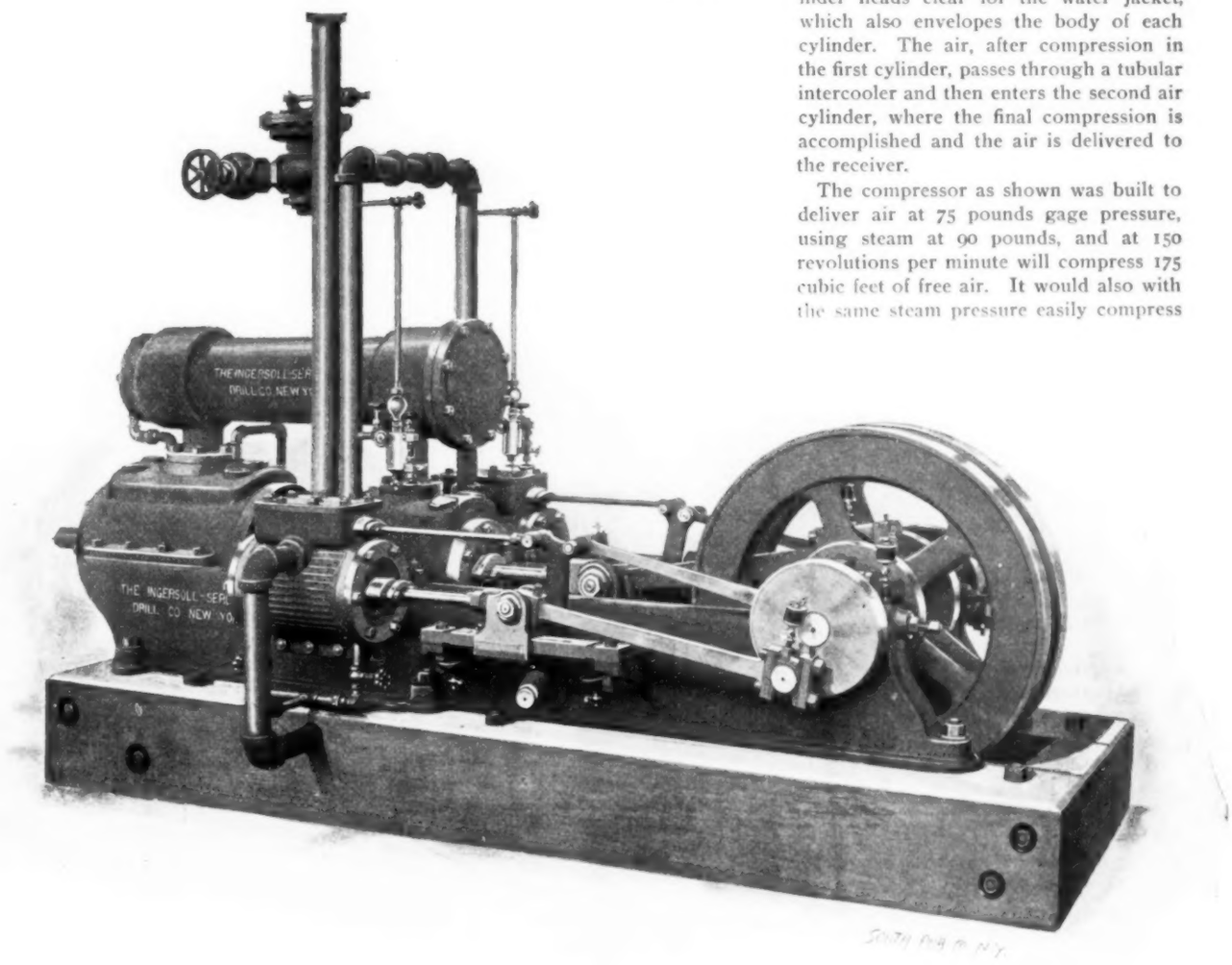
A New Air Compressor.

The accompanying cut shows what is designated as a triple type air compressor recently built by the Ingersoll-Sergeant Drill Company, Havemeyer Building, New York. It illustrates the latest development of the steam-actuated air compressor for independent service and for moderate pressures and volumes of air. The triple feature of the compressor is in the use of three cranks. By this arrangement the machine is without dead points, so that it will always start of itself if sufficient steam pressure is admitted to the cylinders, and the angle of the air-compressing crank to that of the steam-driven cranks is such that the greatest resistance to the air piston comes at the point of the revolution when the greatest effective pressure occurs upon the steam pistons—the reverse of the conditions which prevail with any of the straight-line machines. The arrangement also makes it possible to apply an automatic pressure regulator, whereby the speed of the compressor is adjusted to the air consumption, causing the machine to run slower as the pressure rises, or actually stopping, and starting it again when the pressure falls.

This, as was intimated, is not a large machine as air compressors go now. The steam cylinders, one on each side of the machine, and connecting to cranks 90 degrees apart on the ends of the shaft, are 7 inches diameter and 9 inches stroke. Plain slide valves are used with long valve rods and long rockers, so that the vibration of the rods in the stuffing boxes is very slight. An automatic pressure regulator in the steam pipe, before it divides to the opposite cylinders, is connected with the air receiver and controls the rate of compression.

Two double-acting compound tandem air-compressing cylinders are located in the center and at the back end of the machine. The power for operating them is received from a crank in the center of the shaft and between the two fly-wheels. This crank is 135 degrees around from each of the outer cranks, so that not only are the resistances better disposed with reference to the impulses of the steam pistons, but the cranks serve to balance each other in rotation. The cylinders are 12¼ inches and 7¼ inches diameter, respectively, with the same stroke, 9 inches, as the steam cylinders. The larger or low-pressure cylinder is at the back, and the air is taken in through the hollow inlet pipe or piston rod, and passes through the piston inlet valves into each end of the cylinder alternately. The discharge valves are on the top of the cylinder and work vertically. The arrangement of the valves leaves the entire surface of all the air cylinder heads clear for the water jacket, which also envelopes the body of each cylinder. The air, after compression in the first cylinder, passes through a tubular intercooler and then enters the second air cylinder, where the final compression is accomplished and the air is delivered to the receiver.

The compressor as shown was built to deliver air at 75 pounds gage pressure, using steam at 90 pounds, and at 150 revolutions per minute will compress 175 cubic feet of free air. It would also with the same steam pressure easily compress to 100 pounds. The proportions of the air cylinders may be made different for other delivery pressures, and the steam cylinders may be made cross-compound. It is, of course, unnecessary to say that the machine is excellently made throughout.



A NEW AIR COMPRESSOR.

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Up to a few months ago 1,370 patents had been taken out in this country on rotary engines, and most engineers would value the lot at about 10 cents. Some engines that look like and are called rotaries are really reciprocating engines, however.

ELECTRICAL MACHINERY.

Power Required to Drive Centrifugal Fans.

It is well known that the ordinary centrifugal fan consumes an amount of power depending upon the opening of the outlet and the amount of air which the fan is allowed to pass—an obstruction in the outlet operating to decrease the power consumed, which is at a maximum when the outlet is entirely free. As fans are actually used for blowing fires and many other purposes, the resistance of the fire operates as an obstruction and the power consumed is, during normal conditions, reduced from the maximum. Nevertheless, at various times this resistance is reduced or may be absent, when the power consumed at once mounts up to the maximum.

With fan driven by a belt or special engine, this increase is a matter of little moment so long as the belt or engine is able to drive the fan, and on this account the figures for power given in the catalog of fan makers show what is supposed to be the average or normal requirements. When fans are driven by electric motors, as has come to be very common practice, the conditions are changed, since an electric motor has no limit of capacity beyond which it slows down or stalls, but, on the other hand, takes more and more current in the endeavor to drive the load, until a burn-out results.

Electric motors for fans must then be proportioned with reference to the maximum requirements, and not, as with steam engines, to the mean. In point of fact, large fans for use in heavy operations have been installed with motors based on the catalogued figures for the power requirements, which have operated successfully under normal conditions, but which have wrecked themselves under the increased requirements due to a temporarily thin fire.

By the courtesy of the Interior Conduit & Insulation Company, who have had large experience in applying their Lundell motors to fans, we are enabled to give herewith tables of power requirements for fans for a considerable range of pressure of blast and with various degrees of opening to the outlet up to the full opening.

These are, we believe, the first tables giving the power required by fans under different conditions that have ever appeared in print. The smallest figures for any given condition of pressure are the ones which are usually given as the normal requirement for the fan, and a comparison of these with the figures here given for a full opening will show that the margin necessary for safe work with motor-driven fans is no bagatelle, but a very serious matter.

POWER CONSUMED BY STURTEVANT STEEL PRESSURE BLOWERS.

The Upper Figures of Each Set Give the Power Consumed with the Outlet One-third Open; the Middle Figure, Two-thirds Open, and the Lower Figure Fully Open.

Pressure of Blast.....	4 OZ.		5 OZ.		6 OZ.		7 OZ.		8 OZ	
Size No. of Blower.	Rev.	H. P.	Rev.	H. P.	Rev.	H. P.	Rev.	H. P.	Rev.	H.P.
2	3,103	0.7 1.4 2.1	3,445	1.0 2.0 3.0	3,756	1.3 2.6 3.9				
3	2,456	1.0 2.0 3.0	2,753	1.4 2.8 4.2	3,006	1.8 3.6 5.4				
4	2,224	1.4 2.8 4.2	2,470	1.9 3.8 5.7	2,692	2.5 5.0 7.5				
5	1,814	2.0 4.0 6.0	2,026	2.8 5.6 8.4	2,215	3.6 7.2 10.8	2,387	4.6 9.2 13.8		
6	1,619	2.6 5.2 7.8	1,797	3.6 7.2 10.8	1,960	4.7 9.4 14.1	2,009	6.0 12.0 18.0	2,258	7.3 14.6 21.9
7	1,344	3.6 7.2 10.8	1,507	5.0 10.0 15.0	1,641	6.5 13.0 19.5	1,768	8.3 16.6 24.9	1,898	10.4 20.8 31.2
8	1,200	4.5 9.0 13.5	1,330	6.4 12.8 19.2	1,445	8.4 16.8 25.2	1,565	10.6 21.2 31.8	1,675	13.0 26.0 39.0
9	1,035	5.9 11.8 17.7	1,145	8.3 16.6 24.9	1,250	10.9 21.8 32.7	1,350	13.8 27.6 41.4	1,446	16.9 33.8 50.7
10	902	7.9 15.8 23.7	995	11.2 22.4 33.6	1,085	14.5 29.0 43.5	1,168	18.4 36.8 55.2	1,253	22.5 45.0 67.5

POWER CONSUMED BY STURTEVANT MONOGRAM BLOWERS.

The Upper Figures of Each Pair Give the Power Consumed with the Outlet One-half Open, and the Lower Figure with the Outlet Fully Open.

Pressure of Blast..	1 OZ.		1½ OZ.		2 OZ.		2½ OZ.		3 OZ.		3½ OZ.		4 OZ.		5 OZ.	
Size No. of Blower.	Rev.	H. P	Rev	H. P.	Rev.	H. P.	Rev.	H. P	Rev.	H. P.	Rev.	H. P	Rev.	H. P.	Rev.	H. P.
0	1,863	.15 .30	2,274	.28 .56	2,615	.44 .88	2,912	.6 1.2	3,177	.8 1.6						
1	1,632	.21 .42	1,992	.38 .76	2,291	.60 1.20	2,550	.8 1.7	2,782	1.1 2.2	2,992	1.4 2.8				
2	1,373	.28 .56	1,677	.5 1.0	1,928	.79 1.6	2,147	1.1 2.2	2,343	1.5 2.9	2,520	1.8 3.7				
3	1,167	.40 .80	1,425	.7 1.4	1,638	1.1 2.2	1,824	1.6 3.1	1,900	2.0 4.1	2,140	2.6 5.2	2,279	3.2 6.3	2,527	4.4 8.8
4	1,050	.5 1.1	1,227	1. 2.	1,410	1.5 3.0	1,570	2.1 4.2	1,713	2.8 5.6	1,842	3.5 7.0	1,961	4.3 8.6	2,176	6.0 12.0
5	852	.7 1.5	1,038	1.3 2.7	1,194	2.1 4.2	1,330	2.9 5.9	1,450	3.9 7.8	1,560	4.9 9.8	1,662	6. 11.9	1,843	8.4 16.7
6	726	1.0 2.1	886	1.8 3.7	1,018	2.9 5.7	1,134	4.0 8.0	1,237	5.3 10.5	1,331	6.7 13.4	1,417	8.1 10.2	1,571	11.4 22.7
7	632	1.3 2.7	772	2.4 4.9	878	3.8 7.5	988	5.3 10.6	1,078	6.9 13.9	1,159	8.7 17.3	1,234	10.7 21.4	1,368	15.0 30.0
8	545	1.7 3.4	665	3.1 6.2	766	4.8 9.5	852	6.7 13.4	930	8.8 17.6	1,000	11.1 22.3	1,065	13.5 27.0	1,180	18.2 36.5
9	477	2.2 4.5	583	4.1 8.2	671	6.3 12.7	748	8.9 17.8	815	11.7 23.4	876	14.8 29.7	932	18.0 36.1	1,034	25.3 50.6
10	426	2.9 5.9	519	5.4 10.8	598	8.3 16.7	667	11.7 23.3	726	15.4 30.7	781	18.0 36.1	831	23.7 47.3	922	33.2 66.4
36	362	4.0 8.1	443	7.4 14.8	511	11.4 22.9	567	16.0 32.0	611	21.1 42.1	665	26.7 53.4	712	32.5 64.9	785	45.5 91.0
37	316	5.3 10.7	345	9.8 19.7	413	15.2 30.3	493	21.2 42.5	538	27.9 55.9	579	35.4 70.9	615	43.0 86.1	683	60.3 120.7

The Jacques Carbon Battery.

This invention is creating a degree of interest in the scientific world second only to that excited by the X-rays, though its possible effect upon the human race and upon organized industry entitle it to the first place.

If what its inventor claims be true, it is doubtless one of the most important inventions of the century, and its results are beyond measurement or estimate.

We believe there are no well-informed authorities to-day who are willing to concede these claims as proven, though we believe such authorities consider that Dr. Jacques has opened the most promising line of experiment looking toward the production of electricity direct from coal that has yet been found, and more than this, that he has probably discovered the way in which the problem will be solved if it ever is solved. Dr. Jacques is believed to be a truly scientific man, who aims at looking facts in the face, and not an enthusiast or boomer aiming to magnify the importance of his achievement or to attract attention to himself. It is significant that he says himself: "I believe it will be sometime yet before the dynamo is relegated to the attic with the spinning wheel, or the wheels of the steam engine cease to revolve." Nevertheless, it is plain that he believes that that will be the final outcome.

The essential feature of the invention is the union of atmospheric oxygen with coal under circumstances which prevent combustion taking place, when the energy developed by the union takes the form of electricity. This is accomplished by blowing air through certain liquids in which the carbon is immersed, and which have the property of absorbing the oxygen of the air and then delivering it up to the carbon. The result is the formation of carbonic acid, and the leaving of a residue of ash, as in ordinary combustion, but without combustion, heat or smoke—the development of a current of electricity taking the place of the usual development of heat. The most suitable liquids, or "electrolytic carriers," as Dr. Jacques calls them, are solid at ordinary temperatures, and fire is necessary to render them liquid. In the experiments so far published, about one-half more coal was thus consumed on the grate than was consumed in the pots in producing the electrical current. The fact remains, however, that counting all the coal used, the consumption per electrical horse-power hour was but .559 pound, and this in an apparatus of but two horse-power, in which no very great precautions were taken to prevent loss of heat by radiation or otherwise.

With the apparatus protected from radiation, most of the consumption of heat is in warming the air blown through the liquid, which heat escapes with the resulting gases, and there would seem to be no good reason why, by the use of heaters or regenerators, this escaping heat cannot be used to warm the incoming air, and hence be conserved and its loss prevented. In this way the use of coal for heating the apparatus could be reduced to a trifling amount, and the ultimate possibilities of the process are shown in the fact that with the two horse-power apparatus above referred to, the consumption of coal in the pots per electrical horse-power hour was but .223 pound.

While no one can predict what degree of success may attend the development of the invention, it is obvious that we have here an opening into what may possibly be one of the greatest lines of industrial development the world has ever seen.

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Letters from Practical Men.

Valuation of Manufactories.

Editor American Machinist:

I have been greatly interested in the article on the above topic, by Mr. Oberlin Smith, which appeared in your issue of December 17th.

There are two ways of looking at the value of any manufacturing property. The first way is to take as a basis its cost, with suitable allowance for depreciation; and the second is to take as a basis its earning power; and these may give widely different results. The first plan is the one usually followed in manufacturing plants, and, in fact, many would scoff at the idea of following the second plan; and yet it is far from irrational. When a business has developed to the point where it is turned into a stock company, and the dear public is invited to come in, it is always the capacity to earn dividends which determines the capitalization, and the promise of dividends invariably determines the price of any investment stock, which is but another way of saying the real value set upon the enterprise represented by the stock. Estimating the value of a plant from its cost, ignores the wisdom of the enterprise as a money-making venture, which is the most important single factor connected with it. When we reach the last analysis, a plant from which dividends are hopeless is pretty nearly worthless, regardless of what it may have cost. I know of no more valueless asset than a manufacturing plant, say a rolling mill or a blast furnace, which, while perhaps in excellent repair, is yet so out of date, or so poorly located with respect to the markets, as to be unable to produce its product at a price which will leave a margin of profit.

Of course, I know perfectly well that where dividends fluctuate with the state of business, as they do in manufacturing plants, it would be scarcely practicable to appraise the value of such enterprises on this basis; and yet this is just what is done with railroads. Stocks go up and down in accordance with the promise of dividends, and regardless of the cost of the roads, and the price of the stock shows the real value of the road at any given day. Fundamentally, I can see no reason why the same principle does not apply to a manufacturing plant—the real difference being, that in a public corporation we have in the price of the stock, at any moment, a consensus of opinion on that particular stock, while in a private corporation we have no such consensus.

I do not wish to be understood as advocating this method of appraisal; and yet the manufacturer who ignores the earning power of his plant, in estimating its value, may some day wake up to the fact that he is worth less than he had supposed, and less than his bookkeeper had told him. The fact is, a balance sheet is a greater promoter of hair-splitting than any other known cause—every account balances to a dot, and the profit and loss account shows to a penny just how much has been made, and it is so easy to get into the way of thinking that here at last we have final and exact truth. In point of fact, the great bulk of the items that make up the asset side of the balance sheet, contain a large element of guesswork, and the final sum is but the total of all the guesses. Every manufacturer can tell to a penny how much he must pay to square himself with the world, but what percentage of his accounts and bills receivable he can collect is a matter of guesswork, and the value of his plant—the other main asset—is likewise guesswork.

I have had some experience in these matters, and have appraised plants and product on hand, and directed the balancing of books. I followed the regular plan, and my balance sheets showed the profits figured down to a penny, like other peoples's; but the more of such work I have had to do, the less satisfied I have been with the results. It is pretty much all vanity and vexation of spirit, and the less critical a man is, the more satisfaction he will get out of it.

C. O. GRIFFIN.

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Ships "Made in Germany."

Editor American Machinist:

Your article, "Made in Germany," does not quite cover the entire ground.

To the words "Made in Germany" must be credited the many steamships now plying between German ports and the English colonies. This may seem incredible, but it is a claim made by a large German manufacturer to the writer. The North German Lloyds were compelled to add to their fleet to meet the increased demand for freight transportation.

Before the English tried to protect themselves against the influx of German-made goods, by the "Merchandise Marks Act," the colonies purchased most of their wares from English houses, and thus gave employment to employés, profits to principals and freights to English vessels. The

colonists being informed by the "Merchandise Marks Act" that many of these goods were "Made in Germany," went directly to headquarters to make their purchases, and hence the "Merchandise Marks Act" proved a boomerang in more ways than one. A. M. S.

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Lead of Screw as Affected by Torsion.

Editor American Machinist:

Your answer to S. L. C.'s question, published in the November 12th issue of the "American Machinist," on the effect of torsion when a long screw is being cut, seems to open up a subject which has much more in it than would at first appear.

The angle through which the rod will be twisted varies directly as the length of the rod, and as the force producing torsion—that is, if the limit of elasticity be not exceeded. From this it will appear that the resistance of the tool in the metal will have a marked effect on the torsional angle, and will influence the pitch of the screw more or less, according as the cut is a heavy or a light one. In roughing out, several cuts may be taken, all of which will cause about the same torsional deflection, and so the pitch will remain about the same. But the finishing cuts, being lighter, will cause a much smaller deflection, and the pitch of the entire screw will be changed. The amount, of course, will be very small, but the tool will cut deeper on one slope than on the other, with the result of a badly proportioned thread.

This, of course, is supposing that the metal which is being cut is of equal hardness at all points. If hard places or cracks exist, the effect will be to increase the angle of torsion as the tool passes these points, and to form a screw which would have uneven places in it, caused by the catching of the tool when the hard point was reached, and also when the softer metal was entered.

This inequality in the pitch of the screw at certain points, caused by hard metal, might, it seems to me, be quite serious in some cases, and it would be interesting to learn the experience of those who have met this trouble, and have devised a means of getting around it. W. S. U., Jr.

Philadelphia, Pa.

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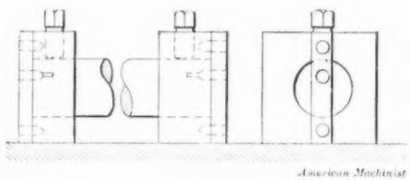
Centering Jigs for Eccentric Shafts.

Editor American Machinist:

I well remember, when I first had charge of the work of building machine tools, what a lot of trouble I had in getting the work to go together right and pass inspection. In those days we bored our holes in the engine lathe or under the upright drill press, and variations in center-to-center distance were quite common, the variation often being so much that gears would not run properly unless mounted on eccentric studs. To properly center these, so that they would have just the amount of eccentricity required to balance the error in location of the holes, sometimes required considerable skill, and so I devised the form of jig shown in the accompanying sketch. It consisted simply of two square blocks, one of which was applied to each end of the shaft to be centered. In a strip of steel passing across the opening was a plain hole made to fit



JIG FOR CENTERING ECCENTRIC SHAFTS.

the countersink, which had a drill on the end of it, so that the center holes were drilled and countersunk at the same operation.

By putting the blocks down on a surface plate before the set-screws were tightened on the work, the center holes were sure to be in line with each other when drilled in the ordinary manner, except that the drilling was done through the jig bushings thus applied, and when there is a good deal of such work, it pays well to make such jigs. Perhaps they are not known to some of your readers and may be needed where eccentric shafts are required for other purposes; although the trouble I designed to obviate, together with a lot of other trouble we used to have to get gears to run properly, has now passed away—thanks to good boring machines, good gear cutters, and generally improved practice of modern times.

F. J. WOODHURST.

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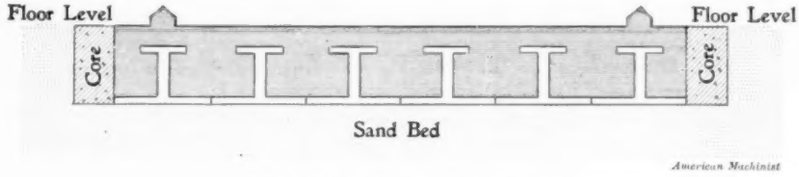
Casting Planer Platens.

Editor American Machinist:

While in attendance at the Foundrymen's Convention in Philadelphia last May, we visited most all the foundries in the city, and saw some very good ideas. Among them was a novel plan for making planer platens. I think it was in Sellers & Co.'s foundry. The foreman was showing us around and describing different things, when we came to something in the floor that looked rather natural, but could not quite understand at a glance. The foreman said: "That is the way we make planer platens here." An old experienced molder, and foreman in one of the largest shops in Detroit, was with us, and remarked to me: "Well, well; here is the kind of a casting that we have been making for years, and could not see such a simple way as that to make it. Is it not simple? No spikes or chaplets to hold the cores down, and we have been so long in the business and have not found it out yet." The foreman explained that they made all their platens in that way, and that there was no danger of the cores rising, because there was more surface on the bottom of the cores than there was left under the T-head, and when the iron was on the bottom of the core it could not rise, and did not need any chaplets or anything to hold it down.

The way to do it is like this: Dig out a hole in the floor and level a bed down as low as will allow the top of the outside cores to come up even with the level of the shop floor. Make the bed hard, as the cope has to be rammed up on it. When you have the bed ready, get your guides or shears and what other pieces go in the top, measure off and place them in position; put on the cope and ram it up, take it off, finish and put it on one side. Now, if your bed is all right (that is, no humps and bumps in it), you can take your measurements and place your cores. If you do not wish to put cores on the outside, you can get a frame and ram the outside up with that. Any size of plate can be made, simply by adding or diminishing the amount of cores.

THOS. WATHEY.



CASTING PLANER PLATENS.

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Milling Cutters With Cast-In Teeth.

Editor American Machinist:

In your issue of November 5th is an article on "Inserted Tooth Mills," by Mr. Arnold, who says "at the Link-Belt Engineering Company, of Chicago, he saw the first examples of mills made by casting steel cutters in a gray-iron body, but it was considered an out-and-out failure." I wish to correct this statement. The mills were not a failure, but, on the contrary, a success, and have been made and used by the Link-Belt Machinery Company, of Chicago, for the past five years. Mr. Arnold has attributed the failure to the mills, which should belong to the kind of work we were trying to do with these mills, which attempt was a failure. We

tried to mill steam joint faces on boiler headers that had large openings and small joint faces, and the waves left by the cutter teeth caused too much labor to grind down, and, economically speaking, the attempt was a failure. We tried solid spiral tooth mills with no better success, and then concluded the fault lay in our milling machine being too weak for this class of work. We then placed these headers on our 8-foot boring and turning mill, and found we could face twice the number of headers, and get true and smooth faces that required very little grinding.

I inclose photos showing a stack of these boiler headers after being finished, and the boiler tubes expanded in them. The joint faces are on the outside, and when the mill passed over the ends of openings it was cutting a broad surface, and when it passed this part and had the two narrow sides to cut, it left the two parts uneven and in waves. I also inclose a photo of one of our boring mills doing the same work to better advantage, as we had two tools at work at the same time, roughing, and then passed one light finishing cut over with broad feed.

I also inclose a photo showing a few of the mills we have made and are using. You will notice there are end and face mills, one with cutters set at an angle. We do not make many of these last mentioned, because it takes more time to grind, and we find it does no better work.

In making these mills we sometimes use Mushet self-hardening steel, but prefer good tool steel, which we cut to length and place in the mold, and flow a sufficient amount of iron through to bring the steel up to a good heat, and they will be found tight in the casting. Occasionally a cutter is a trifle loose, but we calk the cast iron down solid until all looseness is removed. We do this after tempering and before grinding.

These mills are very quickly made, are cheap in first cost, not liable to crack in tempering, are durable, and will stand as heavy duty as the solid steel mills. The mills Mr. Arnold speaks of, that were not finished, were three we made to mill a surface 18 inches wide, and we found we could do the work more cheaply on another kind of machine, so did not finish the cutters, and from this he infers the mills were a failure.

I think it would be economy if more of these cast mills were used, especially in special jobs where not many parts are to be milled, and where a solid mill would be too expensive.

H. K. McLEAN, Supt.,
Link-Belt Machinery Co.
Chicago, Ill.

SOME OF THE LINK-BELT MACHINERY CO.'S MILLING CUTTERS.

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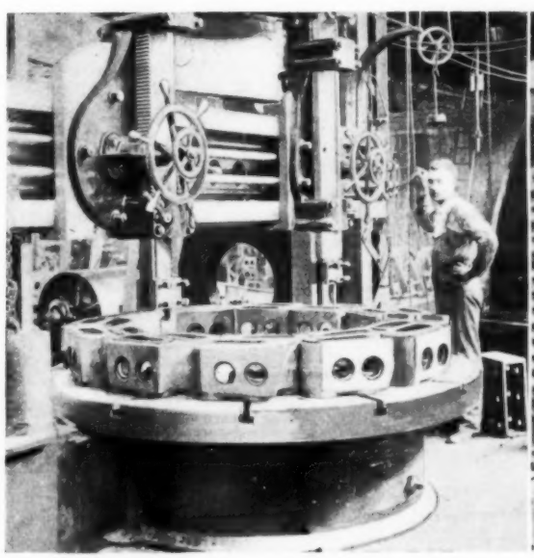
Some Things About Patents.

Editor American Machinist:

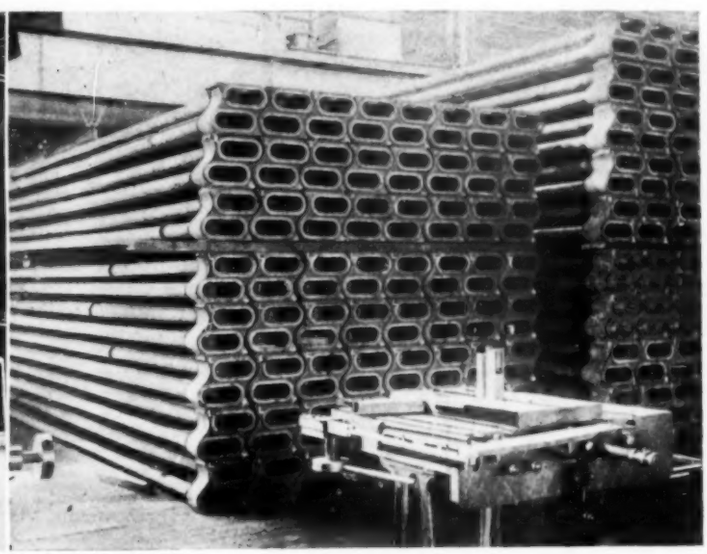
One of the highly commendable features of your management is that you give every fellow a chance to speak his mind, at the same time allowing him plenty of rope, which is so unusual in journalism. There are other features of your management subject to commendation more or less strong, but I am in hopes the above will be sufficient to let me in with my little axe.

"Patentee" got in in yours of 23d. He roasts that old "chestnut," the case of Smith and Jones, for the benefit of your 3,750,000 readers. Too bad that such a thing as he describes between Smith and Jones never yet occurred; but it is always interesting to speculate as to what might happen if such and such things should occur.

Just imagine poor Smith in a United States Court, trying to collect money on a claim based on a conspiracy to defraud innocent purchasers! My eyes! But it is no easy matter to collect under any cir-



"THE SURVIVAL OF THE FITTEST."



THE WORK MILLED.

cumstances; and in this district, an attempt at such a collection would land Mr. Smith where the dogs couldn't get at him, and that long before he could get his hands on the boodle. To be sure, it might be possible for him to bamfoozle the judges, but he would have to perjure himself so high that it wouldn't be safe for him to try to come down.

And there is that other idea of "Patentee's" about taxing the patents. It is like the Yellow Kid of Hogan's Alley—so old it has grown whiskers. Good idea in the minds of many people, but impossible for us to accomplish under the existing condition of affairs. It will readily occur to your journalistic mind that the Constitution of the United States authorizes only "exclusive" protection for "limited" times. The patents have to be issued for terms specified on their faces and cannot be made to expire at the will or neglect of the owner. Many people have undertaken to show us how we could improve on the old Constitution, and some have thought it better to destroy it—and for that purpose have gone so far as to take a whack or two at it—but it is in many respects like the "American Machinist," plenty good enough for most of us, and altogether the best of its class we have on hand just at this writing. Now,

"Nothing stirs a fellow's bile
Just like some other fellow's file."

(That may not be your precise language, but you did say something like that when you dropped into poetry on your first page.) We may be a long way behind European nations, as "Patentee" puts it. We are so far behind them in the matter of patents that, to a man up a tree, it might look as if we were leading the column and they following. Can't say, though, but we have done middling well in the way of "promoting progress" in the "useful arts." The columns of the "American Machinist" show up fairly well alongside of any attempts at imitation on the effete side of the pond. (Am I wrong about that?) And the "American Machinist" continues to grow stronger and handsomer every year, which would not likely transpire if the laws did not favor the manufacturer as well as the editor.

But I am not saying that the laws should not be changed. You are a very powerful engine and can do whatever you like. If I steal a machine belonging to "Patentee," the law permits him to recover his property wheresoever he may find it. This may be all wrong, and if so, it should be righted. The law gives the owner of a patented invention the right to stop its use, no matter by whom it is being used. It is too bad for the user, and "Patentee" might have it fixed up so that a fellow could just get a little bit of a patent, one that would not grant him exclusive protection as now seems to be necessary, but just exclusive enough for the looks of things. Might have it so that if the user didn't wish to be held responsible he should be skipped.

I was sorry to hear about Gelt and the way his claims were twisted to make them cover Frant's machine. The courts are so busy untwisting claims that at first I feared something had gone wrong; but now I see how it is about Frant. Somebody just told him to shut up, and he weakened without striking a blow. He was bluffed.

Yes! We have been letting foreigners in here with their inventions. They take us in with them, but never mind that. We ought to stop it. We are so far behind them that they should give us a chance to catch up. They have such a mass of valuable improvements buried in their musty old records that if they should spring any of them on us we would have to lay down the wrench and couldn't do a thing but just saw wood, unless it be that we could invent something that is really new.

But about these innocent purchasers for whom "Patentee" is so solicitous. You can fix them up without going to the trouble of changing the organic law of the country. Why not notify them through the columns of your paper that all the houses which advertise with you are responsible, and that any one of those houses would guarantee goods against the lawful claims of anyone. This would insure against the goods having been stolen, against them having been mortgaged, or being subject to any liens or other claims, whether on account of patents or what not.

But, Mr. Editor, if you should print any of this, please do not put it under the head of "Letters from Practical Men." We are so in the habit of looking under that heading for information. There is no new thought in this.

PATENTUM.

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Drills—The Reamer Question.

Editor American Machinist:

The interesting article in the "American Machinist" of recent date, "Improving the Twist Drill," brings to mind an incident, or two incidents, connected with the use of drills.

The first commercial twist drill I ever saw brought an order for two extra long ones to be used on a job I happened to be engaged upon. Through a piece eight rather unusually long holes were to be drilled in cast iron, and it was necessary that they be rather better than fairly true. Four of the holes were to be ¾ inch and four ⅝ inch diameter. Just at this time a twist drill "introducer" happened along, and his attention was called to these long holes that were to be. At once the vender proposed to send two drills for trial. He sent the drills, and their work was so satisfactory that the entire system of drilling holes in that shop—it was a large one for the day—was changed.

The drill with the straight flutes I have known for forty years.

It happened a good many years ago, as years go. I had a regular piece job in a shop, but quite disconnected with the shop's business. Times were not very driving, and the foreman, who was also superintendent and draftsman, was anxious to bid low on a job in order to secure it. A very considerable part of the machine work consisted in drilling a large number of holes through wrought-iron links ¾ inch and 1 inch thick, the holes being ¾ inch and 1 inch diameter and 13 inches centers. These dimensions are from memory, and may not be exact. The foreman, for reasons all his own, asked me how much it would cost to drill these holes. Supposing, of course, he would put a bright apprentice or a cheap journeyman, if there is such a thing, at the job, I unhesitatingly gave him an estimate of what it would cost to do the drilling, adding that two or three twist drills would probably be broken in the operation. When it came to the drilling of these links, no one of his drill experts would take the job at less than about double the price named. Finally a piece-worker on a lathe, short of work, agreed to drill the holes at the price named, he to be furnished with all the twist drills reasonably required. He first drilled two of the links, and as every old tool-dresser in the broad land knows how to case-harden the boundaries of such holes a little harder and a little deeper than any other old tool-dresser, they went to the old shop tool-dresser and the templets were ready. An old planer chuck was forced into service, and with a strip of leather to go between the jaw and the templet and the piece to be drilled, the jig was complete. I mention these details only to show that no noticeable expense was incurred in making jigs.

He first started in drilling the larger holes, and in just one hour the twist drill was wrecked. Then something induced him to try what machinists know as the lip drill. I don't mean the lip drill as shown in books, but just that common sort in which the tool-dresser bends the cutting edge that is to be over the edge of the anvil, or a former so as to make a cutting tool instead of a scraper of it. While the tool-dresser was fixing him with a lip drill, he went on drilling with the second twist drill. So many holes were not drilled, but the drill was not broken. He had found the limit of the twist drill.

Then he put the home-made drill at work. I cannot at this time remember how much faster he could drill these holes with the old-time drill than with the twist drill, but it was so much that he had no further use for anything better than he had known from his boyhood days.

This—all this—is in no way against the use of the twist drill. We should be lost to-day without it. It is only an instance in which drilling, accurate enough for the

purpose, could be done much more expeditiously without the most modern appliances.

As a sequel, it may be added that the lathesman who took the holes to drill by the piece found no difficulty in making six dollars a day at the job, and it was low-priced common drilling at that.

It is sometimes an advantage to help stir up a subject, even if you do not add anything of importance to the general fund of information upon it. You may help in bringing out something of value, as witness Professor Sweet's communication on "The Reamer Question," in your issue of December 17th. I hardly think, however, that he is quite fair in accusing Mr. Almond or myself of advocating emery for the purpose named. I cannot speak for Mr. Almond, but I can say for myself that I should never think of using emery, although I can give no good reason why it should not work as well. I can only say that as I use the substances, emery is not fit for the purpose. The pulverized quartz of which I spoke, is to the touch, say, much like wheaten flour—at least to the uneducated finger. Mr. Almond uses Arkansas stone powder, which he can probably defend. I don't know enough about it to speak of it.

For the purpose of which I spoke from my personal knowledge, there was no intention to correct either form or size, or even to bring all the teeth to cut. The only object was to slightly dull, it might be called, such teeth as did cut.

F. F. HEMENWAY.

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The First of the Side Planing Machines.

Editor American Machinist:

The letter from Mr. William W. Hulse, of Manchester, England, in the "American Machinist" of November 26th, renders it incumbent on someone to give other facts in regard to the origin of the side planing machine known in this country as the Richards side planer, and as Mr. George Richards, who could give the story more in detail, may not see Mr. Hulse's letter, I give the following, which is, in brief, the story as he told it to me.

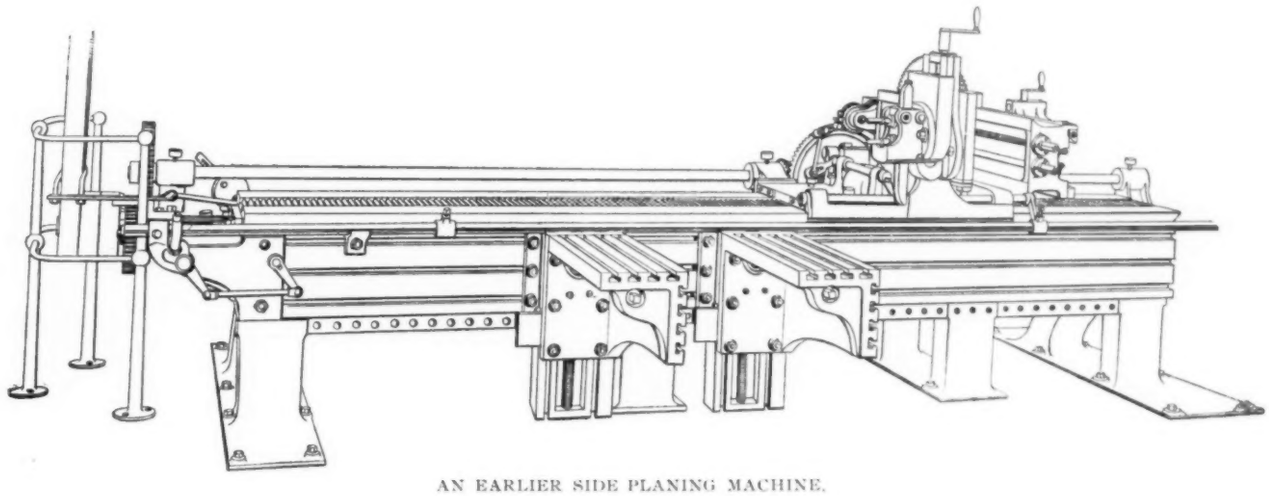
Mr. Richards, while visiting a prominent workshop in Stockholm, Sweden, where he was having work done, in looking over the shop, noticed a side planing machine so like the machines built at Broadheath, Manchester, that he said to the proprietor: "Why did you not give us a chance to build that machine instead of the Manchester people?" He replied that they did not get the Manchester people to build it, but built it themselves, and on inquiring when, they showed him it was between 1858 and 1860, and in 1862 it was exhibited at the London Exhibition of that year. Mr. John Richards brought his out in this country so many years after that he had a right to have forgotten all about the Swedish machine, if he ever saw it; but as Mr. Hulse dates his from 1865, only three years later, it does not seem that he need to have forgotten it so soon.

I have a blueprint from a photographic negative of the machine, and instead of its simply bearing a resemblance to the Richards machine, it is so like it that one has to go into detail to discover the difference.

JOHN E. SWEET.

[On our request, Professor Sweet has loaned us the blueprint, from which we have had made the outline engraving presented herewith. It is evident that the carriage is fed along the bed by rack-and-pinion movement, instead of by screw, and that the arm has two saddles fitted to it; one on each side. We judge that the saddle, which is on the rear side of the arm, is given a reciprocating motion for planing at right angles to the motion of the main saddle upon the bed.

The arrangement for keeping people's clothing or hands from being caught in the belt or gears at the left is something that might with advantage be more generally imitated here.—Ed.]



AN EARLIER SIDE PLANING MACHINE.

Box Tool for Tapers.

Editor American Machinist:

All who have to do with the class of turret lathe work requiring the cutting of tapers will, I think, agree with me when I say that it is the most difficult and expensive of any style of work to be done by that most useful of machine tools.

There are various complicated devices attached to some of the modern machines which require the time and patience of a first-class mechanic to study out and get into successful operation. I call to mind at this writing, a case of a hustling young tool-maker, in first taking charge of the tool-room in a large factory near Boston. In looking around the shop for something to "conquer," he stopped in front of two little engine lathes, "clattering along" at a fast speed, with one man, "turning up" taper pins of about ½ inch diameter, 5 inches long, two on a piece, and cutting them in the middle after they were turned. The h. y. tool-maker went at once to the foreman of that department and quietly asked him if there was a taper-turning device attached to that new turret lathe. The answer came: "Yes; but we did not succeed in making it work very well," and after some talk over the taper pins and the two engine lathes, it was decided that the new tool-maker should "rig up" the turret for the taper-cutting.

Of course he was successful and soon had the pleasure of seeing the chips curl out with a cloud of smoke from the hot oil.

A time trial was made on 150 taper pieces against the man on the two engine lathes, with the result that (in counting the time in getting the tools and device in working order on the turret lathe) the two old lathes continued on the job as usual, while the foreman of the department whistled softly to himself and thought of the days when he also was young.

The above-mentioned incident, however, by no means condemns the cutting of tapers in the turret lathe; numerous economical and labor-saving devices have been applied to such work; the most suc-

cessful of those I have noticed being the ones designed for the special product to be made, rather than the universal attachments furnished with the machine.

A sketch and explanation of a taper turning box tool (designed and put in operation by the writer) might be of use to some of your readers.

Figs. 1 and 2 show the body of the tool, made from a solid round machine steel forging, milled to the form shown.

The elongated holes *a b c* and *d* (Fig. 2) are for the escape of the chips from the cutters.

Figs. 5 and 6 show the tool complete.

A sample blank (Fig. 3) is required for each size of taper to be cut. Shank *a'* of sample is turned the size of the rough stock to be used; the sample is then placed in the jaws of the automatic chuck; the box tool being in place (not tight in the turret) is slipped up over sample, and a slight pressure of the thumb on screw *e* will set the cutting edge of tool *f* down on the taper sample. A part turn of set screws *g h* and *i*, and setting-down of knurled screws *j k*, will complete the setting of one cutter; by turning the tool in the turret for setting the other three cutters, it will always bring the screws more convenient to manipulate. After all are set, clamp the shank of the tool in place, remove the sample blank, feed in the bar of machine steel, and we are ready for work, with total time of setting the tool nine minutes.

The cutter shown at Fig. 4 is made from ⅜ x 1¼-inch tool steel, finished to fit free in the slots of holder, and ground true by clamping on a parallel block and running by the face of the emery wheel on a B. & S. universal grinder.

The capacity and wide range of tapers this tool will cover can be seen at a glance. The tool as shown in this drawing is designed for dowel pins from ½ inch to 1⅛ inches diameter (large end), 1 inch to 6 inches long, any taper inside of ¾ inch per foot.

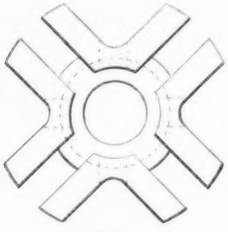


Fig. 1

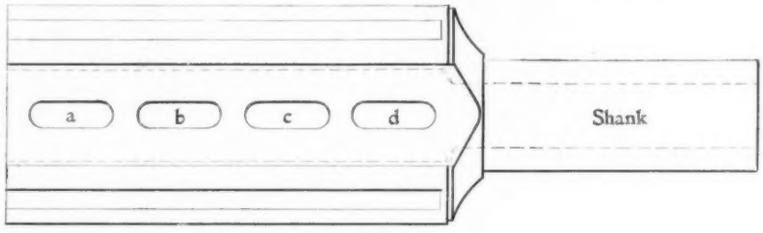


Fig. 2

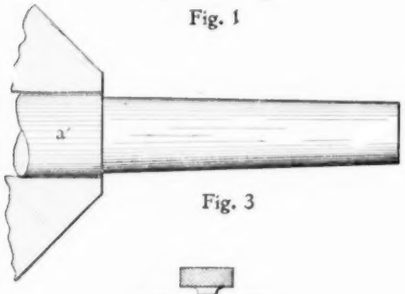


Fig. 3

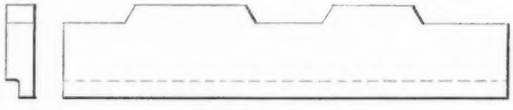


Fig. 4

Fig. 7

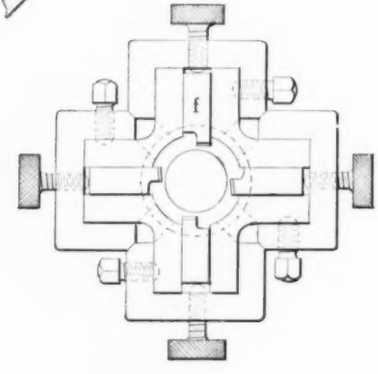


Fig. 5

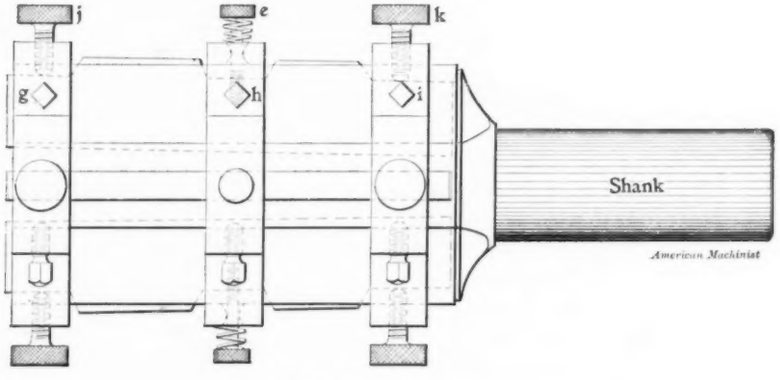


Fig. 6

BOX TOOL FOR TAPERS.

Fig. 7 shows top view of style tool used for cutting off and forming both ends of the pin at one cut, being used in the tool post of the cross-slide.

D. E. MACCARTHY.

Detroit, Mich.

▲ ▲ ▲

Friction of Water in Pipes.

Editor American Machinist:

Although your editorial comments of December 10th relieve me of the necessity of replying to Mr. Cooper's remarks upon my pipe formulæ, a few words may nevertheless be advantageously expended in further answer to the same.

By "long pipes" are meant, as you have already pointed out, those in which loss of head from all causes other than friction is negligible. About 1,000 diameters is a sufficiently accurate inferior limit of what constitutes a long pipe in this sense.

The working formulæ which I gave were for water pipe, not for capillary tubes, with or without "feather edges." They conform very closely to Darcy's celebrated equations for diameters from 2 to 4 feet; for smaller ones, down to 6 and 4 inches, they give somewhat larger deliveries than does Darcy, because he uses a co-efficient varying with the diameter, which I have omitted as unnecessary in ordinary practical calculations. Below these last-named sizes it is rarely required to make fine calculations. For instance, we would not expect to determine by calculation the flow through a 2-inch pipe closer than, say, 10 per cent.

Mr. Cooper's remark, that "when a constant enters as a direct factor and in one [formula] is 50 per cent. more than in the other, it looks very much like guessing," is a pregnant one. It points directly to the weak pivot upon which pipe calculations turn. The question of roughness and smoothness *is* guess-work, within the limits fixed by the formulæ given. That is to say, experience shows that the greatest degree of smoothness or roughness of a cast-iron pipe, under ordinary

practical conditions, varies as regards delivery from 1 to 1.40. This is the best that "applied science" can do for us in this particular line. But this is an immense deal, and clears the way for common sense and common prudence to step in and dictate that, since all water pipes are liable to become very rough in time, through interior incrustation, we should, in designing a permanent system, use a factor of safety; i. e., employ the formula for rough pipes.

I am glad to embrace, with your permission, this opportunity to still further generalize my formulæ for rough pipes, by throwing both into one, and to nail the whole with an example. Thus, the one sufficient formula for rough, long pipes is

$$\frac{D^5 \times H}{Q^2} = 1$$

in which D = diameter in feet, H = fall per 1,000, and Q = cubic feet per second.

Now for the example: What net or theoretical horse-power is needed to pump 2,000,000 gallons per diem through an 8-inch pipe line 1 mile long, into a reservoir 100 feet above sump?

In the formula

$$H = \frac{Q^2}{D_5}$$

substitute $Q = 310$, and $D = \frac{8}{9}$. Then

$$H = \frac{9.61}{\frac{32}{243}} = 73$$

Since the distance is one mile, the total hight at the rate of 73 per 1,000 is 385.44. Adding hight of reservoir gives 485.44. Finally,

$$H\,P = \frac{3.1 \times 485.44}{8.82} = 170.6$$

That is, 171 theoretical horse-power would be required to do the work.

One word, in conclusion, as regards the very excellent observation quoted from Professor Sweet, that "the way to see the truth or absurdity of a thing is to carry it to extremes." By all means; only let us be sure that the "thing" we carry does not become some other thing on the way.

E. Sherman Gould.

Yonkers, N. Y.

[For the benefit of readers who are not acquainted with hydraulics, we may say that the value 73 feet per 1,000, which Mr. Gould has found for H, is the friction head. That is, the friction due to pumping 3.1 cubic feet per second through 1,000 feet of 8-inch pipe is equal to an addition to the actual head of 73 feet, which for a mile of pipe, becomes 52.8×73 or 385.44. The divisor 8.82 is the number of cubic feet per second which, raised 1 foot, consume a horse-power.—Ed.]

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"Testing in the Schools."

Editor American Machinist:

It seems to me that the tone of your editorial upon this subject, in the issue of November 26th, indicates a misapprehension of the conditions under which the schools have to work, and also of the object of the testing work done by them. While it may be true that, in some places, efficiency is made the sole and only end of a test, I think that most of the laboratories consider this as only a side issue in the experiments, the main object being to cultivate the powers of observation of the student, to familiarize him with the working and handling of machinery, and to drive home the facts about the action of machinery that he has learned in his classroom work. If this is not the use made of laboratory work, then the course should be remodeled with this end in view.

In order to accomplish the results mentioned, the student should not only make and record observations, and derive the ordinary results, but he should change the conditions under which the machine runs, and note and explain the difference in results obtained. While difference in efficiency should undoubtedly be considered, the speed of working and capacity of a machine should be kept in view and emphasized, and, as you indicate in your article, the desirable working qualities noted.

In regard to the problems of construction, they are, as you admit, quite as much a matter of drawing-board work as of laboratory testing. The invention and introduction of new types of commercial machinery is not, and should not be made, a function of school work, except as a matter of co-operation with, and testing for, manufacturers. The function of the school is to teach the student the facts and principles underlying the science of engineering; and this cannot be too much nor too often emphasized, for it is a matter about which there is a great deal of misapprehension among both manufacturers and teachers. To bring out clearly why and how these facts apply, *is* a part of the work of the school, and, so far as it can be made useful for this purpose, the design and construction of machinery should be included in the school course; and I am of the belief that it can be so used to a much greater extent than is the case in most schools at present. In this connection, assisting manufacturers to improve their machinery is a true function of the school; and I am inclined to think that, if the manufacturers will make a move to secure this assistance, they will find the schools ready to meet them more than half way, for such work is recognized by nearly all schools as of great benefit to students. But the building of machinery of new types, and of doubtful success for the purpose of cheapening processes of manufacture, and so putting money into other people's pockets, is a thing for which the schools have neither time nor energy, even if the needed funds were available.

A difficulty which will occur to anyone who has had to do with the laboratory work of students, is that accuracy of observation and recording of results, sufficient to allow the deduction of reliable conclusions from them, is almost impossible to get, except after a considerable experience in testing. I doubt if any manufacturer would be willing to risk his money, or his reputation, on conclusions drawn from experiments made by a student who has had but 50 or 60 hours of laboratory work. A comparison of the results which are obtained by students in their thesis experiments, which are uniformly accurate and reliable, with the errors which attend their first efforts at experimentation, will show that the gain in carefulness and attention obtained are worth the time and expense now put into laboratory work.

The schools stand ready and willing to assist manufacturers in improving their machinery and methods, so far as they can do it without injuring the student, and if the manufacturer will bear his share of the expense. But the school exists, and its funds are given first of all for the benefit of the student, and any perversion of the time, energy or funds of a school to the subservience of manufacturing interests is an injury to the school and to the cause of education.

Arthur L. Rice,
Pratt Institute.

[To clear up any misapprehension of our position in this matter, we will refer to the experiments of Professor Goss, on paper friction wheels, which appeared as a paper before the recent meeting of the American Society of Mechanical Engineers, as a typical illustration of the class of experimental work which, we think, might, with benefit to all concerned, replace a good deal of the testing now done. The educational value of such work is just as high as that of any other kind of experimental work; it leads to positive contributions to the world's stock of knowledge, and it is free from the evil influence of so much testing, which is to lead the student to feel that the chief object of an engineer's life is to find the ratio between output and input, which it is not, never was and never will be.—Ed.]

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The Limit Tap.

Editor American Machinist:

In your issue of November 26th I was much interested in the article by Horace L. Arnold, on "Limit Taps." It strikes me, however, that there might be some objections to this style of tap. All mechanics know that a twist drill does not always follow the exact path it was intended to, even if started correctly. This being the case, would it not be natural for the "limit tap" to follow the hole in its winding path? This would not occur to any extent in a short hole; but supposing he had a hole 1½ inches deep to tap with the ½-inch tap, might not this thread wander enough to interfere with close-fitting screws?

Glasses.

Oshkosh, Wis.

American Machinist.

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We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

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An Organization on Both Sides and Reason Between.

It seems almost incredible, but is nevertheless stated in trustworthy journals, that considerable numbers of shareholders in the London & Northwestern Railway Company promised to hand over their next dividends to help the cause of organized employés who were preparing to fight the company because it had discharged a number of them for refusing to leave their organization, and general public sentiment was so unanimously and strongly opposed to the action of the company that it was compelled to yield and reinstate the men.

American experience with industrial difficulties also has shown that such a position assumed by an employer will not receive the support of public opinion, and, in fact, will have its opposition unless there has been very great provocation. It is, we think, coming to be quite generally recognized that there is not necessarily evil in combinations of either employers or of employés, but that combinations of either kind can and in fact often do wrong things.

The difference between merely organizing or belonging to an organization and doing well or ill with the organization after it is formed, is shown by the somewhat remarkable, interesting and instructive career of the Stove Founders' Defense Association.

This is an association of manufacturers of stoves, which was organized in 1886 to resist by concerted action what was regarded as the unwarranted and unjustifiable interference of labor organizations with the rights of manufacturers. For several years it was what might be called a belligerent organization. Its acts were mainly defensive, however, and finally led to an understanding between the two organizations, which, it is asserted by both sides, is entirely satisfactory. As a result of several conferences, it was agreed that there should be no more strikes nor lockouts, but that all differences between molders and their employers should be referred to the presidents of the two organizations for settlement, and if they should not be able to agree, to a committee composed of three members of each of the organizations.

Such general rules as are adapted to the business, and which could, from their nature, be fully discussed and agreed to, have been adopted, and special difficulties as they arise are settled by calm discussion, reason, and sometimes by mutual concessions. At least one case has arisen wherein a reduction of wages which had been agreed to by both the foundry owner and his employés (owing to what were considered special conditions) was objected to by the employers' organization, on the ground that it gave an unfair advantage to that particular manufacturer in competition with other members making the same line of goods, and wages were restored to the standard figure, molders in other foundries being, of course, interested in and in favor of the restoration.

In a pamphlet now before us, the Defense Association gives as its aims, Justice, Peace, Friendship and Contentment. Surely these are worth striving for, and while much can be and in fact is said in favor of absolute individual freedom to work or not to work, to employ or not to employ, and to agree upon any mutually satisfactory rate of payment, it yet remains true that if there are to be organizations of one or both sides it is far better that these apply to business affairs of mutual interest, the methods of rational beings.

* * * "We walk evermore
To higher paths, by brightening Reason's lamp.

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The "American Machinist" Abroad.

One of our Berlin friends remarked the other day that "everybody reads the 'American Machinist' in Germany. You must have more subscribers there than in any other foreign country."

The fact is we have many more subscribers in Great Britain than in Germany, and, of course, "everybody" does not read the paper in either country, but our friend is one of the wide-awake machinery men of Germany and naturally comes into contact with men of the same class there, and the paper is so generally read among such men as to easily give the impression that "everybody" reads it.

Mr. Chas. Davis, of Cincinnati, who has recently returned from an extended and very successful trip abroad, says he has no hesitancy in going on record as believing that the "American Machinist" has done more than any other one influence in introducing American machinery abroad and in building up our foreign machinery trade. He found the paper everywhere he went, and found the wide-awake and progressive machinery men of every country familiar with it.

We have much other evidence that we have done an important work in helping to keep American machine shops busy during the past few years, and we hope to do still more in that direction. It is, of course, very gratifying to us to know that we have thus helped to keep some wheels turning here that might not otherwise have turned quite so busily during the past year or two.

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Strength of Shafts.

The article and diagram on stresses in shafts, by Mr. A. L. Hopkins, which we publish this week, will be found of interest and value to all who have to do with designing or laying out large shafts for combined stresses. It will be seen that in order to make use of a diagram, Mr. Hopkins has had to develop a new formula, as the standard ones are not capable of graphical representation.

While it is true that this new formula is really an empirical one, yet it gives results which are surprisingly close to the ones proposed by the standard authorities—the differences being of no importance in practical design. The net result is a formula which is not only capable of being represented by a diagram, but one which is of itself simpler than those which have heretofore been used. We consider Mr. Hopkins' article a distinct contribution to practical design, simplifying the problem as it does, and substituting diagrammatic work for somewhat tedious computations. It ought to lead to rational design in many cases where guesswork and rule-of-thumb have heretofore prevailed.

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This number closes the nineteenth volume of the "American Machinist," and we look forward to the new year with confidence of being able to approach still closer to our ideal of what such a journal should be. We contemplate no radical or striking change for the coming year, but shall endeavor to make each number as valuable, as, within practicable bounds, we know how to make it. The results of the past year's work have been very gratifying to us, and we have substantial evidence that the paper has grown in influ-

ence and in the estimation of its friends. Its circulation among the best and most influential mechanics and machinery men generally, of this and other countries, has increased in a very gratifying way, and the numerous letters and spoken words of commendation from our own countrymen, and from foreign readers, testify to a very kind and hearty appreciation of our efforts to make the paper worthy of the craft and of the interests it represents. To all our friends we wish a happy and a prosperous New Year!

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We frequently receive suggestions from our readers regarding the paper, and in most cases these suggestions are accompanied by an apology for making them. We take occasion to say that suggestions are always welcome; in fact, we invite them, and are glad to receive them whether we can adopt them or not. Sometimes there are reasons, not at first apparent to those who make these suggestions, why we cannot avail ourselves of them, but we are glad to receive them nevertheless, and hope any reader who would like to have the paper different in any respect, or would like us to take up any subject, will feel free to favor us with his views, and we invite him to do so.

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It has heretofore been our custom to send out the index with the last number of the volume. The index for this year will be, we think, better arranged and more complete than any that have preceded it, and it will be sent to mail subscribers with the first issue of the new year. All other readers can obtain it free by sending a request on postal card.

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Literary Notes.

COMPEND OF MECHANICAL REFRIGERATION. By J. E Siebel, Director Zymotechnic Institute. 304 4½ x 7½-inch pages H. S. Rich & Co. Price, $2.50

This book contains an outline of the theory of refrigerating machines, in which the subject is presented as simply as is probably possible. Part II, which occupies the most of the book, covers the practical application of principles and discusses the different systems of refrigeration, giving rules and formulæ for proportioning different parts of the apparatus. The book concludes with a collection of tables useful in refrigeration work, and with a collection of numerous examples, worked out to show the methods of using the more important formulæ contained in the body of the book, which of themselves are made as simple as possible. The book fills a field in which there is considerable demand, and fills it well.

TABLES SHOWING LOSS OF HEAD DUE TO FRICTION OF WATER IN PIPES. By E B. Weston, C. E. D. Van Nostrand Co. 170 4¼ x 6¼-inch pages. Price, $1.50.

This book cannot be otherwise than of great use to all who have occasion to make calculations regarding the flow of water in pipes, and too much praise cannot be accorded to the industry involved in the extended calculations involved in its preparation. In view of the labor thus expended, the price of the book is remarkably low. Two main tables comprise the bulk of the book. The first is for pipes having very smooth interiors, such as those of lead and brass, this table being computed from a formula deduced by the author from the results of two hundred and thirty-eight experiments. The second table is for new cast-iron pipes, and was computed from D'Arcy's formula, after the same had been verified by comparison with one hundred and forty-eight experiments. A third supplementary table is given by which the results from the main tables may be converted into those to be expected from cast-iron pipes after various terms of service. The tables give the velocity of the water, the velocity head, the entry head, the friction head and the discharge in United States gallons per minute and per twenty-four hours. For smooth pipes the range of the tables is from ½ inch diameter with a minimum discharge of ¼ gallon per minute, up to 3 inches diameter with a maximum discharge of 1,100 gallons per minute. For cast-iron pipe the range is from 4 inches diameter discharging a minimum of 10 gallons, up to a diameter of 60 inches discharging a maximum of 64,000 gallons per minute. Supplementary tables are also provided for obtaining results beyond the limits of the main tables. Illustrative examples of the various uses of the tables are given, and serve to make the matter plain to those who may not be acquainted with theoretical hydraulics. The book will undoubtedly become a standard work of reference by all who have problems in hydraulics to solve. It is strongly bound in leather and will endure the thumbing which it is bound to receive.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(208) D. B. H., Philadelphia, refers to the article on the Sprague worm-geared electric elevators which appeared in our issue for November 5th, and asks how the worm of the single-worm machine is fastened to the shaft, and if the gear wheel of the double-worm machine is parted elsewhere than through the center. A.—The worm of the single machine is secured by taper pins as shown in the engraving of the double machine. The gear wheel is parted through the center only, as shown in the engraving—most clearly at the bottom—the left-hand gear being in the form of a ring.

(209) J. F. F., Cold Spring, N. Y., asks for a rule for determining the proper number of 16 candle-power incandescent lamps to illuminate a given amount of space. A.—A good general rule is to allow one 16 candle-power lamp for each 100 square feet of floor space when the lamps are 7 to 8 feet above the floor and fairly well distributed, which will give fair though not brilliant illumination. If the lamps are grouped in a few chandeliers, or are at a high elevation, more should be used. It is quite obvious that good judgment must be a large factor in work of this kind.

(210) J. H., Cadwalader, Pa., has a bevel paper friction gear which will not drive without slipping, and he asks the reason why. The large wheel is 40 inches diameter by 7 inches face, and makes 300 revolutions per minute. The small wheel is 18 inches diameter. The power to be carried is 35 horse-power. A.—You are overworking the gears. The experiments by Professor Goss show that a pulley of one inch face, having a lineal speed of 1,100 feet per minute, will transmit a horse-power. The mean diameter of your large wheel is about 34 inches and $\frac{34 \times 3.14 \times 7}{12 \times 1100} = 17$ horse-power, nearly. Professor Goss states that this figure can be exceeded by excessive pressure, but his experiments were with parallel shafts. With bevel gears the heavy end thrust and consequent collar friction might be quite a factor. The paper wheel should be the driver.

(211) "Chicago" writes: 1. Under questions Nos. 210 and 270 of last year I find the heat units for water given at 80° F. = 80 heat units, and at 60° F. = 60 heat units. In all the tables I have I find water at 80° F. = 48 heat units, and at 60° = 28 heat units (omitting all fractions). I see that by adding 32 in each case I come out all right. How does it come? A.—Our correspondent's statement seems to answer the case completely. The tables usually start with the water at 32°, or the melting point of ice, while we counted it from zero. Our practice, as in the cases referred to, is sometimes more convenient, while either is correct if used intelligently. 2. In question No. 210 of last year, is the computation for the dimensions of an external tubular boiler? Do these rules also apply to an internal tubular boiler, and if not, what are the modifications? A.—As the question referred to had only to do with the evaporative performance of a boiler, and had nothing to do with relative grate area or heating surface, the rules there followed will apply to any type of boiler.

(212) H. W. B., Philadelphia, asks: 1. What is the proper area for a safety valve? Should it equal the area of the feed pipe? A.—Safety valve areas are computed rather from grate-bar than from feed-pipe data, although both have to do with the generation of the steam which the safety valve is expected to dicharge. The rule of the United States Supervising Inspectors of Steam Vessels requires with lever valves 1 square inch of safety valve area for each 2 square feet of grate surface, and for spring or "pop" valves 1 square inch of area to 3 square feet of grate surface. 2. Which will dry a piece of wet cloth the sooner, a cylinder made of sheet copper 1-16 inch thick, or a cylinder made of sheet steel the same thickness, both cylinders being steam tight and heated by steam at the same temperature? The cloth is laid on the cylinder body. A.—While the conductivity of copper is more than double that of steel, there would be probably little appreciable difference in drying effect with the two metals; the rate of evaporation would be determined by the ability of the cloth and its contained moisture to absorb the heat, rather than by the ability of the metal to convey the heat. The condition of the surfaces of the two metals would be an important factor. The steel

surface should be free from scale or oxide, or the copper would have an advantage on that account.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 14.

Machinery castings. H. D. Phelps, Ansonia, Ct.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Ideal Twist Drill Grinder. T. Hall, 853 B'way, N.Y.

Engine Castings ½ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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Death of H. L. Lufkin.

Mr. H. L. Lufkin, manager of the sales department of the Crocker-Wheeler Electric Company, died on Monday the 21st of December, of peritonitis resulting from an operation for appendicitis.

Mr. Lufkin had just returned from a business trip to the West, but was taken ill before resuming his duties at the office. He was born in 1857, and had been associated with Messrs. Crocker and Wheeler almost from their first work on electric motors—having been with them in the management of the C. & C. Company, before the organization of the Crocker-Wheeler Company. He was one of the first to become convinced of the wide applicability of electric motors, and in a business sense was a pioneer in this field of work. While an enthusiast on the subject, his enthusiasm was not the mere optimism of a half-informed man. On the contrary, he was an expert electrician and had an accurate knowledge of the forces with which he was dealing. This was a large factor in his business success, as it gave him correct ideas of what could be legitimately expected and prevented many disappointments to himself and his customers. We know personally of cases in which he advised against the use of motors, although they were technically entirely feasible, but in his judgment did not offer sufficient promise of increased economy to make them desirable in a business sense.

Mr. Lufkin's enthusiasm and courage were well shown at the Electrical Exhibition held in this city last June, of which he, as one of eight, assumed the financial responsibility. The exhibition developed into a great success and gave ample return for the risk assumed, but we know something of the anxiety connected with it before its success was assured by the patronage of the public.

Mr. Lufkin was a man of engaging personality and a great favorite with a large circle of friends. He was very approachable, and always ready to lend a helping hand. Our electrical columns have been indebted to him for many suggestions. He leaves a wife, but no children.

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Death of James Kearney.

Mr. James Kearney, one of the best-known file-makers of America, died at his home in Riverside, North Newark, N. J., on the 18th inst. Mr. Kearney began his connection with the file business at the early age of ten years, in the city of New York, at which time he was apprenticed to a man who made for wholesale jewelers and dealers in jewelers' supplies, a small line of fine files similar to the Stubs and Swiss patterns. Mr. Kearney filled these orders by carrying them from factory to store in a basket, and learned the business of file-making in all its branches. About 1860 he attempted to make files by machinery, but owing to the prejudice against machine-cut files and the lack of efficient machines, this venture was unsuccessful. He afterward became associated with Mr. Geiger, of Newark, N. J., and the firm of Kearney & Geiger were prosperous manufacturers, in a small way, for several years, after which Mr. Kearney retired and went to Paterson, where he formed a partnership with Mr. Veit Weinmann, under the firm name of Weinmann & Kearney. Business was carried on under this name until about 1875, at which time Mr. J. D. Foot, president of the present Kearney & Foot Company, bought Mr. Weinmann's interest in the business, and from this on, the business grew into its present large proportions.

Mr. Kearney, like most self-made men, was a man of strong character and pronounced views. In early life he met with an accident by which his hearing was very much impaired, and this curtailed and narrowed his social life; but those who were privileged to know him intimately, knew him as a companionable gentleman, always to be relied upon for assistance where merited, and at his home he was highly esteemed as an excellent citizen. At the time of his death Mr. Kearney was in the sixty-fifth year of his age.

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American Machinery in Europe.

Mr. Chas. Davis, of Cincinnati, has just returned from a trip of six months in Europe on business and recreation. He visited Russia, Sweden, Norway, Denmark, Austria, Germany, Belgium, France and England. He reports a great demand for American machine tools and secured some very large orders for his company. He reports a remarkable development now going on in Russia. The Russian Government is encouraging the industries of the Empire by important concessions, and orders of large magnitude to manufacturers in that country.

Mr. Davis devoted considerable time to the Pan-Russian Exposition held at Nijni Novgorod, on the Volga. This was the largest and most important exposition ever held in Russia. He reports a most remarkable showing there made by the iron industries of that country, and has promised to give us for publication some particulars regarding this, which we think will prove interesting.

Mr. Davis considers Russia to be ahead of any country in the world in many branches of manufacture of iron and copper, and submitted some samples of rolled sheets of iron and copper that were used as the business cards of the Russian manufacturers in that line.

Mr. Davis corroborates the statement made by us that only the better grades of machine tools, and those having a special adaptability to the purpose required, can find a ready market in Europe. This has become so much the fact that the term "American" has become synonymous with "high quality," and the best that any European manufacturer claims for his product is "as good as the American."

Mr. Davis is just from the great London Cycle Show, held at the Crystal Palace, December 5th to 12th, where his company had a display of tools devoted to the manufacture of bicycles. The Pratt & Whitney Company, the Garvin Machine Company and other American builders were also represented. He reports the show, which was the largest ever held there, a great success, heavy orders having been secured by all the American exhibitors. The English makers were represented, but their orders were largely confined to tools that could not be quickly delivered by the American builders.

The Davis & Egan Company have opened a store in London at No. 7 Leonard street. This street has lately taken on considerable dignity as an American tool center, Churchill & Co. being located at No. 9. Incidentally, it may be mentioned that much American furniture is also sold in that section of London, one firm having just received twenty-seven carloads from Grand Rapids.

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The younger Mr. Diechmann (A. Otto), of the firm of Gustav Diechmann & Sohn, Berlin, is now in this country, renewing acquaintances among our American machinery builders and informing himself regarding the latest developments here. His firm is engaged in the work of introducing American machinery into Germany, and he reports not only good success so far, but that the prospects for future business seem to be altogether favorable. His father, Mr. Gustav Diechmann, was for many years one of the engineers connected with the Krupp Works, and when leaving that establishment, became the representative for the Tweddel hydraulic machinery in Germany; this leading to his becoming finally represen-

tative for other concerns in England, and now for many of our best-known American establishments. Mr. Diechmann states that there is what may almost be called a craze for American machinery in Germany and some of the other continental countries, and that in many cases buyers will have nothing else if they can find American tools at all adapted to their requirements, and a surprising feature of the business is that some of our heaviest tools are now imported into Germany. Mr. Diechmann thinks, also, that in the near future the Russian market for American machinery will be one of considerable magnitude, as he thinks great developments will take place there.

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Inspection of Machinery in Japan.

We note in the London "Engineer" for December 11th a letter from Tokio on the above topic, which is a distinct warning to English manufacturers against selling goods for Japan under the existing conditions of inspection and acceptance. The warning is just as pertinent to American machine builders, and we are glad to reproduce its main points here.

It appears that the conditions attached to such purchases are that the goods shall only be accepted after inspection in Japan, and this inspection is so foolishly minute as to reject the goods for defects which are such in imagination only. It appears, for instance, that all paint is removed from castings, every square inch is minutely inspected, and every little roughness or hammer mark is noted. The correspondent states that he has seen steel boiler flues which were obviously good in every way, literally covered with hundreds of painted rings, each one indicating an imaginary flaw. These flues were, however, after a great deal of delay and expense, finally accepted.

Another case which had a different outcome was that of 10,000 tons of cast-iron pipe supplied by Belgian founders for the Tokio waterworks, of which only 2,700 tons were accepted. This pipe was actually examined by a microscope all over its surface, and where the size permitted it, inside as well as out. The correspondent states that he has seen numbers of good pipes rejected because they were half a millimeter (one-fiftieth of an inch) below specified thickness at one single spot of their surface. Under these circumstances, it is gratifying to learn that, on later inquiries, not a single firm could be found which would quote prices for pipe.

These requirements are laid down by the Government; but we infer that they apply not only to direct government purchases, but to all goods imported into the country. As an illustration of the spirit of the inspectors, the cheerful statement is made that machinery is assumed by the inspectors to be bad until it has been proven to be good. "In other words, if the Japanese inspector does not know whether it is good or bad, it is rejected."

The correspondent concludes that these absurd requirements are largely due to the lack of experience of Japanese engineers, who have high theoretical attainments, but little else except strong, conscientious zeal. We have seen somewhat similar though not quite so ridiculous performances in this country, and from a very similar reason.

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The annual dinner of the Central Railway Club will be held at the Hotel Iroquois, Buffalo, N. Y., on Friday, January 8, 1897.

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Commercial Review.

NEW YORK, SATURDAY EVENING, DEC 26TH.

A SYMPOSIUM UPON THE MACHINE TOOL MARKET.

The "American Machinist" does not this year follow its former annual custom of publishing a great many letters from manufacturers upon the condition and prospects of the machinery business, that matter being now covered by the regular reports in this department, but inquiries have been made of a few metal working machinery companies and the letters printed herewith have been received in reply. We present this week but a small number, which have been received, however, from various parts of the country other than this immediate locality, which has been pretty thoroughly treated of already. We hope occasionally in the future to publish similar letters from other manufacturers.

The character of these reports is, in general, conservative, although as cheerful as the circumstances permit. The distinction between these two elements is strongly brought out if in analyzing them we discriminiate between what refers to the past and present and what refers to the future, the former being questions of fact while the latter is, of necessity, chiefly a matter of opinion.

As far as past and present events are concerned, the letters state or imply, with practical unanimity, that the year has not been an ideal one, nor is there sufficient in them to show that business has as yet begun to improve to any appreciable degree. The companies represented have, however, weathered the storm with greater or less equanimity and have not been idle meanwhile in improving or extending their plants. We made no reference in our inquiry to the export trade, and although this is spoken of in some of the replies as a feature of the market, we do not think that its relative importance is fully brought out. We know that the Brown & Sharpe Manufacturing Company and the Niles Tool Works have had a heavy export trade, and doubtless this is true of others.

With respect to the future the letters are disposed to assume a hopeful tone. Of course people, except when it would be to them a political heresy, have been assuming a hopeful tone for the last four years, and, whatever happens, people will be found assuming a hopeful tone for the next four; but there does seem, nevertheless, to be some ground for thinking that we have approached a time when the remaining obstacles in the way to prosperity are not so impassable but that a little faith, as well as hope, might be entertained. One of the sources of demand, when times will permit it, to which attention is especially called, is the steam railroads, another the street railways.

From the Betts Machine Co., Wilmington, Del.:

"Considering the very dull times we have gone through with, the year just drawing to a close has been a fairly good one for us. We have had a moderate output, a large percentage of which has been for export. We don't know what to say of the future. We had supposed that the result of the elections would have indicated, at least, some little return to prosperity, but we see no improvement whatever. There is still a prevailing lack of confidence, and the closing days of a year are always of a 'waiting' nature."

From the Bickford Drill & Tool Co., Cincinnati, O.:

"This year has been a somewhat trying one as far as business was concerned. It was decidedly dull, at times, and especially in the months preceding the election. We, however, employed that time in moving out of our old plant, tearing it down, and building the present structure, which we have. We are now again back at the old site in the new building, and have a decidedly modern and model shop in every particular, measuring 75 feet in width, and 125 feet in depth, and four stories high. In a previous issue of the "American Machinist" we already described the arrangement of the interior of the shop. Now in regard to the outlook we wish to say that it is decidedly hopeful. We have not had, for a long time, the amount of encouraging inquiries which we have now, and all from large concerns for large tools. It has been hard to close very many large deals in this country, but we think the first of the year will bring a decided amount of business quickly. In the line of bicycle machinery, on which we were quite busy a year ago, we are not doing so very much, although we fully believe we are getting our share of the bicycle business, which is being placed. Our foreign trade, however, is increasing to a great extent and it is a decidedly nice trade to have, and we are well satisfied with it. Taking the whole past year, as a total, we are decidedly well satisfied with it, considering the fact that even if business was not good, it put us in position to equip ourselves for the next year's business so as to handle it when it comes. Our tools have been overhauled, new ma-

chines added in all departments, and we are equipped better than ever before."

From the Billings & Spencer Co., Hartford, Conn., manufacturers of machinists' tools and drop forgings:

"In our business December shows a slight improvement over the last four or five preceding months. We anticipate a more satisfactory business from now on, and to illustrate our faith in same would say that we are carrying as large a line of material and goods as we ever had in the works."

From the Brown & Sharpe Manufacturing Co., Providence, R. I.:

"In regard to the conditions and prospects of the machine tool business, would say that it is at the present time, and has been during the past year, unsatisfactory as far as sales in this country are concerned, but for the future there seems to be a more hopeful feeling, based largely on the belief that the gold standard is to be maintained; but there is still enough uncertainty in regard to tariff matters to prevent manufacturers from enlarging their plants or starting new enterprises. We believe there will be a gradual improvement in all kinds of business during the year 1897, but no boom, unless unhappily a foreign war should take place, in which case, undoubtedly, the demands for arms and war material would stimulate the machinery business in many lines. There has been a substantial increase in the amount of business we have done in 1896 over that in 1895. The number of hands employed January 1st was 1,148, which number has been increased during the year to 1,328. The works have been run ten hours per day throughout the year. Fifteen old machine tools have been taken out and one hundred and twenty-two have been added."

From W. P. Davis, Rochester, N. Y.:

"Business has not been good with us for the past year, at the same time we have run about the same number of men, and have found market for our tools, but the prices have been exceedingly low. We have had a small export trade through the export houses and direct from dealers on the other side. I believe that trade will gradually increase with the New Year. The fact that there have been so many machines exported from the United States, especially in the machine tool line must improve chances in the home market. We have been improving and perfecting our line of engine lathes, and now make from 12 inch to 30 inch swing and any length of bed required, and have also improved our key-seating and cutting-off machines, and have just brought out a new broaching machine intended for bicycle work. We are now fully settled in our new plant, and the entire building is devoted to manufacturing and sales rooms with all modern conveniences for handling work that we manufacture and sell."

From Chas. C. Newton, proprietor of the Newton Machine Tool Works, Philadelphia, Pa.:

"In respect to the business out-look, I have to say that the depression of the last four years will, undoubtedly, make a large demand for all iron work, in the near future. I know that railways are suffering for locomotives, and that every department of industry is in need of new machinery and of improved facilities for the production of work. I think it is only a question of time when manufacturers will have a fair share of business. The Cuban question has, undoubtedly, retarded this somewhat, as Congress seems inclined, as usual, to interfere with other people's affairs, rather than attend to the needs of our own country."

From the Niles Tool Works, Hamilton, O.:

"The outlook for the machinery business is promising. Our line is about the last to feel the effects of improved business conditions. Idle machinery must first be put to work before additional machinery is required. The low prices of all classes of machine product are compelling manufacturers to look about for

(Continued on page 39.)

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Pos. wanted, country, by young M. E. D, AM. MACH.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

All round machinist and tool maker wants position. Box 220, AMERICAN MACHINIST.

Tool maker, first-class, used to drawings, wants position. Box 221, AMERICAN MACHINIST.

Pattern makers—3 A 1, reliable exp. men.; N. Y. city work; state wages. Box 224, AM. MACHINIST.

Practical and successful designer, A 1 draftsman, 20 years' varied experience, designer of high grade engines, desires position. Box 263, Ridgway, Pa.

Wanted—First-class, all-o round blacksmith; permanent position for right man; state age and experience. Atlanta Machine Works, Atlanta, Ga.

A first class tool die maker and draftsman wants a change; 15 yrs.' exp.; interchangeability of parts a specialty; investigat on courted. Box 219, AM. MACH.

Wanted—A mechanical d'ftsman (practical) who has had some experience on printing presses. State ref., age and wages expected. Box 223, AM. MACH.

Mechanical Draftsman Wanted—One who has had experience and is capable of designing special automatic machinery for working iron and brass castings. Address Box 210, AMERICAN MACHINIST.

Milling machine foreman is open for engagement; used to Brown & Sharpe Universal and all kinds of milling on machine tool work; gear cutting; can make tools for machines; best of references. Box 225, AMERICAN MACHINIST.

Technical graduate, with 7 years' experience in shop and in charge of design and erection of high speed engines and power plants, wants position as erecting engineer or draftsman; well qualified. Engineer, Box 61, Hartford, Conn.

First-class mech'l dftsmn, is open for engagement as inspector, ass't eng'r or draftsman; thoroughly competent to est. system in dwg. room; tech. edu.; 4 years' heavy eng. work and power plants; Corliss especially; best of refs. Box 215, AM. MACHINIST.

Wanted—A young assistant, as partner, by a practical constructing and erecting engineer with an established business; one familiar with steam and electrical work preferred, and who can invest $5,000 to $10,000, and will devote energy and close attention to a paying and rapidly growing business. Possibly a technical graduate, desirous of becoming a contractor, associated with a man of twenty-five years' practice, can address at once, Box 226, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Wanted—Carbonized wire for chain rivets. Box 217 AMERICAN MACHINIST.

All kinds of engines and machinery built to order. New Jersey Machine Works, Newark, N. J.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E O. Chase, Newark, N. J.

Special mach'y for manuf. of bicycle chains. Full particulars. Garrard, Ryland st., Birmingham, Eng.

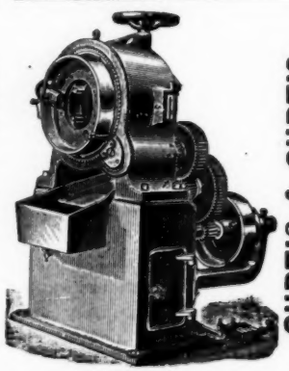
For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Wanted—Engine with automatic cut-off, about 50 H. P.; must be in perfect condition; give full particulars and price Box 222, AMERICAN MACHINIST.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st. N.Y.

Wanted—An Idea. Who can think o some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.



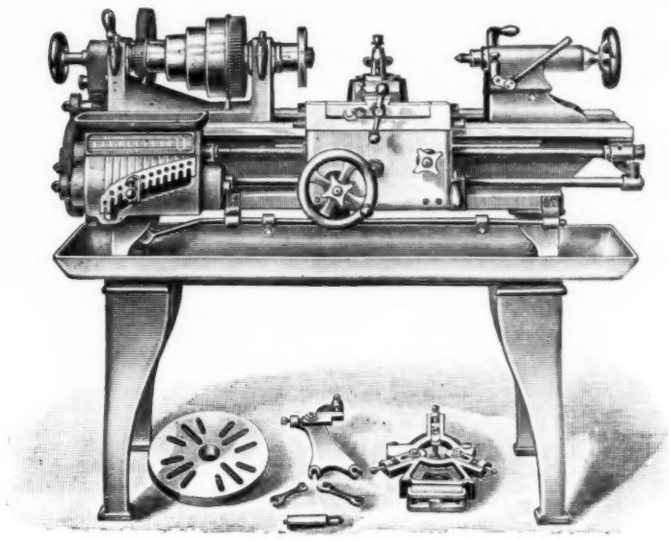
CURTIS & CURTIS,
66 CARDEN ST., BRIDGEPORT, CONN.
Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

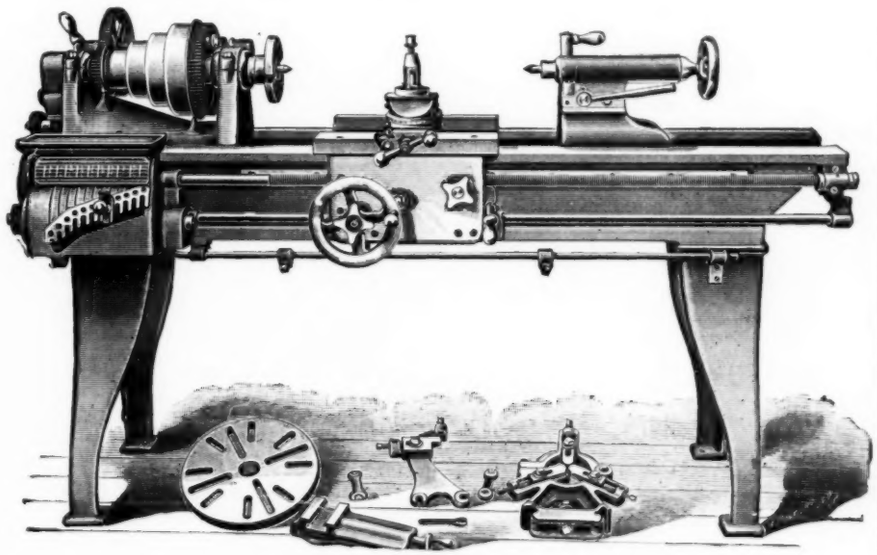
Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

Automatic Solid Die Bolt
THREADING MACHINES.
Two Styles. Four Sizes.
Send for Catalogue "A."
WEBSTER & PERKS TOOL CO.
Cor. Spring and Monroe Sts.,
Springfield, Ohio.



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents: Chas. Churchill & Co., London and Birmingham, Eng.
Schuchardt & Schütte, Berlin and Vienna.
Eugen Soller, Basel, Switzerland.

(Continued from page 38.)

improved machinery to reduce cost, and machinery builders will have an increased business from this source. Machinery twenty or thirty years old will not answer under present conditions. Improvement in monetary conditions will eventually lead to increased business in lines similar to ours. When bonds for the construction of railroads and for other enterprises can be floated, business will come to us. We anticipate a large extention of electric railway lines. Compressed air is also receiving considerable attention, and may be adopted extensively by suburban lines, all of which will call for machinery for building engines, electric machinery, compressors, cars and other equipment. We have been fortunate during the period of trouble (which we trust is now at an end), running fully two-thirds of our force full time. We have taken advantage of the times to make many improvements in the plant and the product. Our main improvement has been the construction of a new foundry building, which enables us to handle all classes of work to great advantage."

A machine tool establishment whose name we do not feel at liberty to mention, but which is a very important one, sends the following communication, which, although brief, is perhaps as significant as any of the rest.

"We beg to say that business conditions are such that we prefer not to say anything for publication at this time."

Quotations.

NEW YORK, Monday, December 28th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $13 00
No. 2 foundry, Northern	11 50 @ 12 00
No. 2 plain, Northern	11 25 @ 11 50
Gray Forge	11 00 @ 11 50
No. 1 foundry, Southern	11 50 @ 12 00
No. 2 foundry, Southern	11 00 @ 11 25
No. 3 foundry, Southern	10 50 @ 11 00
No. 1 soft, Southern	11 00 @ 11 50
No. 2 soft, Southern	10 50 @ 11 00
Foundry forge, or No. 4 Southern	10 25 @ 11 00

Bar Iron—Base—Mill price, in carloads, on dock; common, 1.10 @ 1.15c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c and upward.

Machinery Steel—Ordinary brands, from store, 1.65 @ 1.70c.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11⅝ @ 11¾c; electrolytic, 11⅜ @ 11¼c.; casting copper, 11c.

Pig Tin—For 5 and 10-ton lots, 12.90 @ 12.95c., f. o. b.

Pig Lead—In carload lots, 3.05c., f. o. b.

Spelter—In carload lots, New York delivery, 4.10c., f. o. b. and upward.

Antimony—Cookson's, 7¼ @ 7¾c.; Hallett's, 6⅝ @ 6¾c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 40 @ 42c.

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Manufactures.

At Catasaqua, Pa., a new cement factory is being erected.

At Gray, Me., Mr. Frank Douglass will erect a steam saw mill.

At Carthage, O., Block & Pollak are erecting a large rolling mill.

The Rudolph Paper Company, York, Me., intend to install new machinery.

At Middleburg, N. Y., it is reported that a canning factory is to be commenced.

At Cambridge, Mass., W. Elston & Co. are to install a new steam engine and boiler.

At Chattanooga, Tenn., the Chattanooga Sheet Metal Works will build an extension.

The Atlantic Refining Company, Philadelphia, Pa., are building a new brick factory.

The Sinclair-Scott Company, Baltimore, Md., intend to build a new plant in that city.

Wilcox, Crittenden & Co., Middletown, Conn., are building an addition to their plant.

At Winnipeg, Man., Kelly Bros. are making preparations for erecting their asphalt plant.

The Toledo Brazed Fork & Tube Company, Toledo, O., will build an addition to its plant.

At Sisterville, Wheeling, W. Va., the Hays Iron & Steel Company will put up new buildings.

Schoolfield, Polk & Co., of Pocomoke City, Ind., intend to make extensive additions to their plant.

At Philadelphia, Pa., Mr. George Brouse will erect a planing mill at American and Norris streets.

Matthai Ingram & Co., Baltimore, Md., are putting up new buildings and making other improvements.

At Kansas City, Kan., a new flour mill is to be erected. Mr. E. G. Blair, of Atchison, Kan., is interested.

The Colvin Foundry Company, Providence, R. I., contemplate the erection of a new foundry and pattern shop.

The Nardle-Tynes Foundry & Machine Company, Birmingham, Ala., intends to install new gold mining machinery.

At Mannington, W. Va., a large window glass factory is to be erected. Mr. A. M. Fox is one of the prime movers.

At Fonda, N. Y., Mr. H. S. Hilton, of Schenectady, N. Y., has leased the Fonda Knitting Mill, and will add new machinery.

William Weightman, of Philadelphia, is to erect a new factory to be used for light manufacturing purposes on Commerce street.

The Morgan Engineering Company, Alliance, O., will erect and operate an extensive tin plate plant in connection with their works.

The Kennet Mining Company, Anaconda, Mont., of which W. B. Millard is general superintendent, expect to erect a reduction works in the spring.

At Indianapolis, Ind., a new brewery is to be erected by the American Brewing Company, of which J. C. Schaf, Herman Halrich and Eugene Bretney are directors.

The extensive machine shops of the Northern Pacific R. R. at Glendive, Mont., were recently destroyed by fire. Almost all machinery and four engines under repair were destroyed.

A. Lucas & Sons, at Peoria, Ill., is the name of a new company, capital stock $25,000, to manufacture architectural iron. Incorporators: Adam Lucas, Emil E. Lucas and Hugo V. Lucas.

Lockwood Tubular Well Machine Company, at Peoria, Ill., has been formed to manufacture well machines. Incorporators: Elias R. Lockwood, Lucia K. Lockwood and H. R. Daugherty.

The Kootenay Iron Works is looking for a location at Nelson, Wash., to erect a large foundry. Messrs. A. R. Burrow, Geo. W. Richardson and Geo. A. Bigelow, Spokane, Wash., are interested.

At Pittsburg, Pa., a new steam laundry is to be erected, and will be called the New Method Laundry. The most improved machinery will be installed. Mr. Jas. A. Reed is president of the company.

At Leadville, Mo., a new mining company has been formed, in which J. E. Hacker, Greenville, Tenn., C. P. Colton, Canastota, N. Y., are interested. New pumps and machinery will be installed.

International Mattress Machine Company has been formed at Chicago, capital stock $100,000, to manufacture and sell mattress machinery. Incorporators: John H. Whipple, Robert Vansands, Arnold Heap.

Fifth Wheel Manufacturing & Pipe Bending Company, of Flushing, L. I., has been incorporated; capital, $150,000. Directors: Richardson C Layton, T. W. Rydsdale, of Brooklyn, and Charles J. Goulden, of New York City.

At a meeting of the board of directors of the Ranken & Fritsch Foundry & Machine Company, St. Louis, Mo., held December 15th, they decided to liquidate the affairs of the company, and pending a reorganization or a sale of the property to take no further contracts. At the same time the hope is expressed that the business will be reorganized and operations resumed.

The Pratt & Whitney Co. HARTFORD, CONN., U.S.A.

...MAKERS OF...

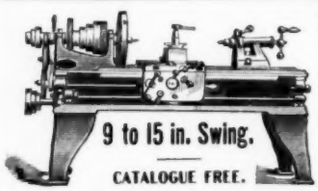
Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

England—Buck & Hickman, 280 Whitechapel Road, London, E.
France—Fenwick Freres & Co., 21 Rue Martel, Paris.
Germany and Austria—Schuchardt & Schutte, Berlin and Vienna.
Chicago—42 and 44 South Clinton St. *Boston*—281 Franklin St. *New York*—123 Liberty St.

Fine Reamers, Taps, Dies & Screw Plates
IN GREAT VARIETY.
"LIGHTNING" and "GREEN RIVER BRANDS"
SEND FOR CATALOGUE.
WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.
Agents in London, Selig, Sonnenthal & Co., 85 Queen Victoria St.

The Principles of Mechanism
By Prof. S. W. ROBINSON.
325 Pages. 433 Cuts. 8vo, Cloth, $3.00.
JOHN WILEY & SONS, 53 E. 10th Street, New York City.



SPEAKING OF LATHES! We are building them in various sizes from 9-in. to 15-in. swing, in various lengths, both engine and speed lathes. Our designs are the latest and most approved, while the workmanship, material and finish are of the highest order. Our catalogue will tell you all about them, as well as of our planers, shapers, drills and other tools and supplies.
SEBASTIAN LATHE COMPANY,
CATALOGUE FREE. 117 and 119 CULVERT STREET, CINCINNATI, OHIO.

DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N.Y.
Have done all my patent soliciting work, both for this and foreign countries, continously for the past fourteen years.
Thomas A. Edison

STAR LATHES
★★★
Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12' Swing.
Send for Catalog B.
Seneca Falls Mfg. Co.
687 Water St., Seneca Falls, N.Y.

WE CLAIM THE FOLLOWING MERITS FOR JENKINS BROS.' VALVES.
1. Manufacturered of the best Steam Metal.
2. No regrinding, therefore not constantly wearing out the Seat of the Valves.
3. Contain JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
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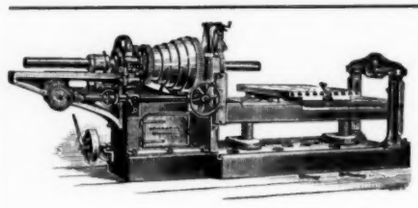

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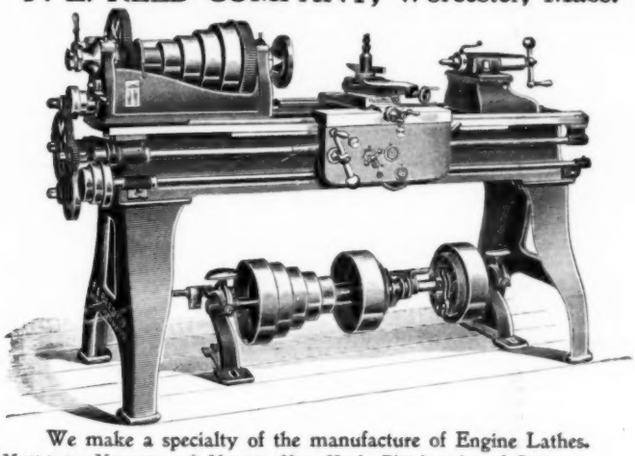

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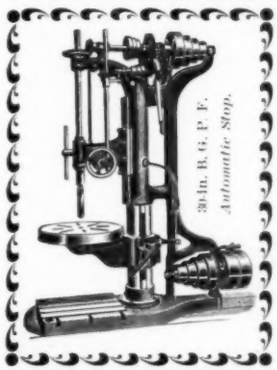

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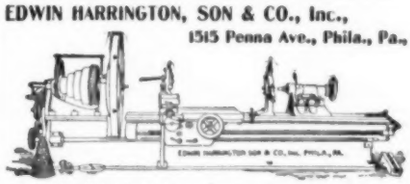

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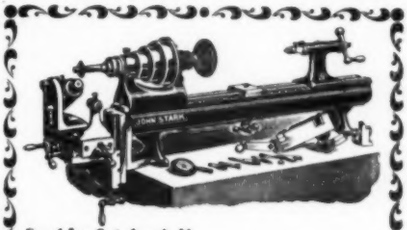

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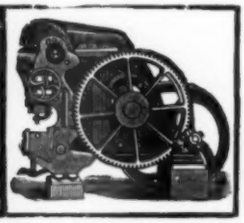

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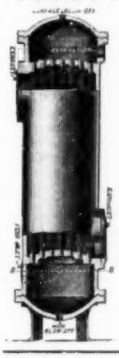

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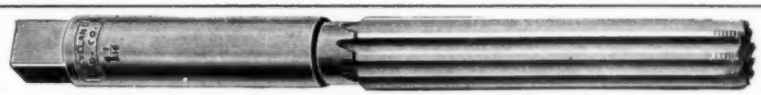

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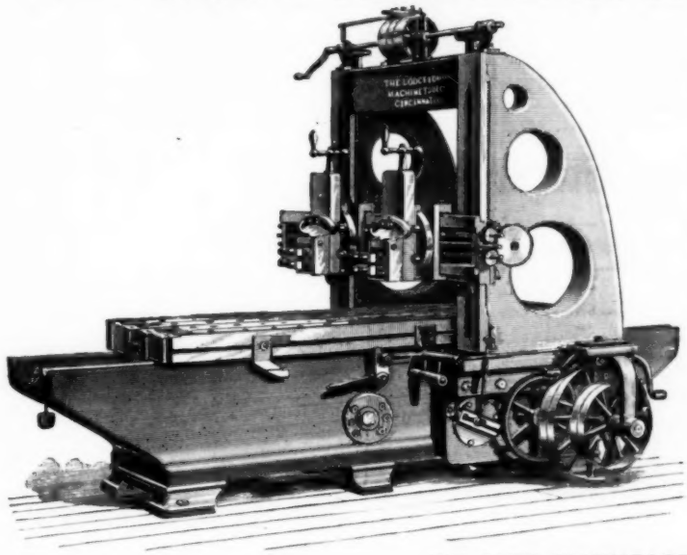

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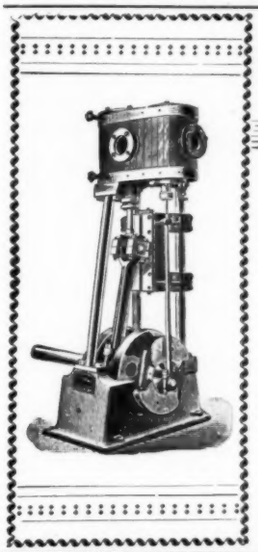

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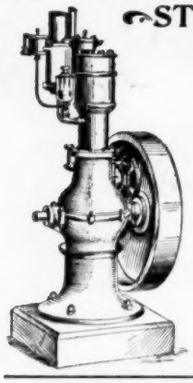

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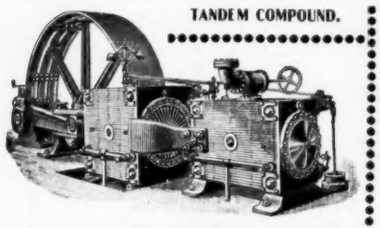

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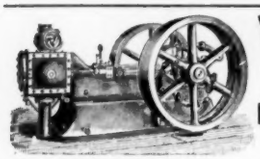

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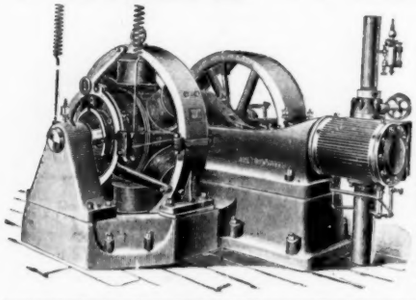

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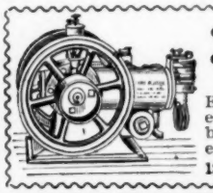

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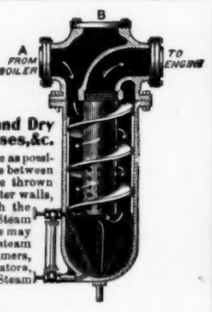

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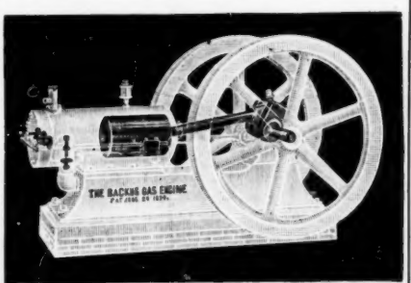

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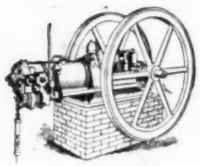

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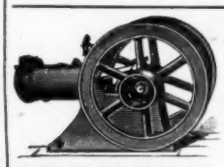

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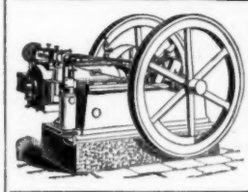

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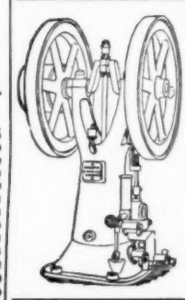

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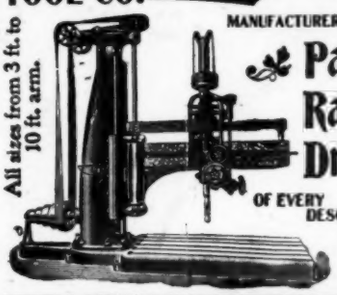

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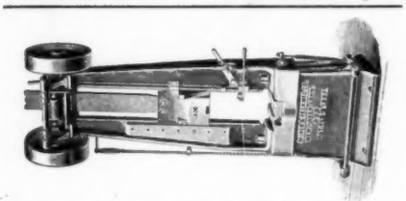

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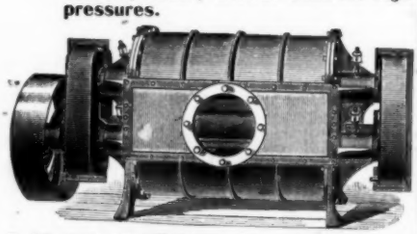

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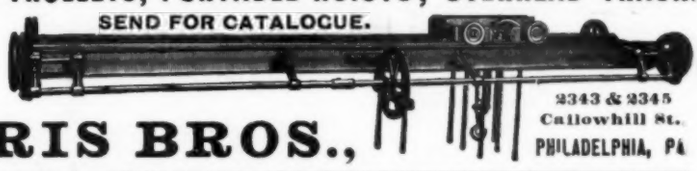

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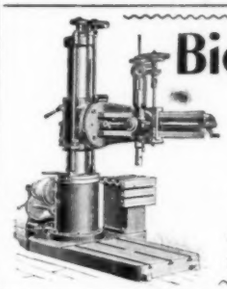

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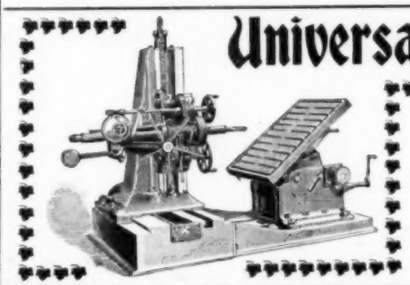

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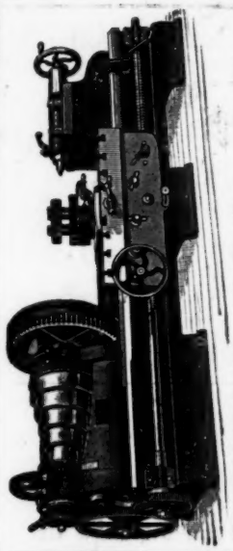

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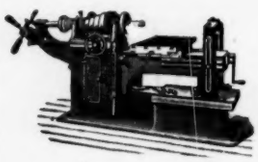

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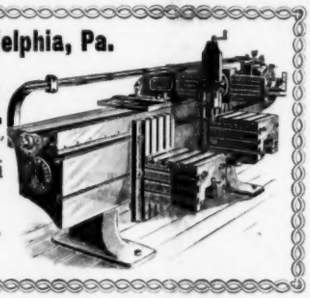

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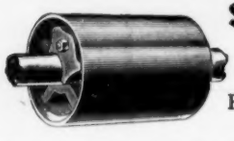

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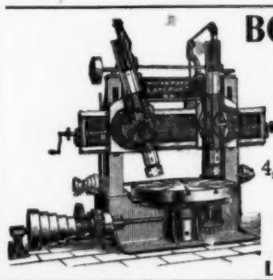

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